



Proposed Plan of Action

AT&SF Albuquerque Superfund Site Albuquerque, New Mexico

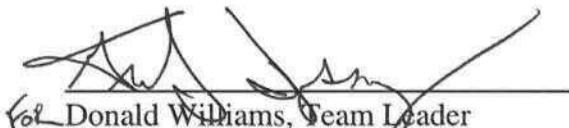
January 2002

**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
SUPERFUND DIVISION**


**Proposed Plan of Action
AT&SF Superfund Site**


Greg J. Lyssy
Remedial Project Manager

1/18/02
Date


Donald Williams, Team Leader
Technical Support Team

1/22/02
Date


James L. Turner, Senior Attorney
Office of Regional Counsel

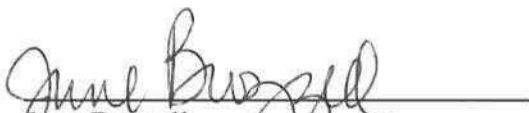
1/29/02
Date


Wren Stenger, Chief
Louisiana/New Mexico/Oklahoma Branch


1/29/02
Date


Mark A. Peycke, Chief, Superfund Branch
Office of Regional Counsel


01/31/02
Date


June Buzzell
Writer Editor, Superfund Division

02/01/02
Date


Pamela Phillips, Deputy Director
Superfund Division

Date


Myron O. Knudson, P.E., Director
Superfund Division
EPA Region 6

2/1/02
Date

Proposed Plan of Action AT&SF Superfund Site

Table of Contents

1.0	Introduction and Community Participation	Page 1
2.0	Site Background	Page 4
2.1	Site Location and Physical Description	Page 4
2.2	Site Operational History	Page 4
2.3	Summary of Site Investigations	Page 6
2.4	Previous Response Actions	Page 8
3.0	Site Characteristics	Page 10
3.1	Physical Site Characteristics	Page 10
3.2	Current and Anticipated Future Land and Ground Water Use	Page 10
3.3	Site Hydrogeology	Page 11
3.4	Nature and Extent of Contamination	Page 11
3.5	Principal and Low-Level Threat Wastes	Page 15
3.6	Scope and Role of Response Action	Page 16
4.0	Summary of Site Risks	Page 17
4.1	Contaminants of Concern	Page 17
4.2	Land and Ground Water Use Assumptions	Page 18
4.3	Potentially Exposed Populations	Page 18
4.4	Toxicity Assessment	Page 19
4.5	Human Health Risk Characterization	Page 20
4.6	Ecological Risk Characterization	Page 20
4.7	Basis for Action	Page 21
5.0	Remedial Action Objectives and Goals	Page 22
5.1	Remedial Action Objectives	Page 22
5.2	Basis for Selection of Remediation Goals	Page 23
6.0	Summary of Remedial Alternatives	Page 25
6.1	Common Elements of Remedial Alternatives	Page 26
6.2	Alternatives S-1 and GW-1 - <i>No Further Action Alternative</i>	Page 29
6.3	Alternative S-2 - <i>Excavation and on-site disposal</i>	Page 29
6.4	Alternative S-3 - <i>Excavation, solidification/stabilization, on-site disposal, and capping</i>	Page 30
6.5	Alternative S-4 - <i>Excavation, soil washing, and on-site disposal</i>	Page 31
6.6	Alternative S-5 - <i>Excavation and bioremediation</i>	Page 31
6.7	Alternative S-6 - <i>Excavation and off-site incineration</i>	Page 32
6.8	Alternative S-7 - <i>In-situ solidification/stabilization</i>	Page 33
6.9	Alternative S-8 - <i>The Preferred Soil Alternative - In-situ solidification/stabilization and run-on/run-off management</i>	Page 34
6.10	Alternative GW-2 - <i>UV-oxidation treatment, filtration, carbon adsorption and disposal of ground water</i>	Page 35

Proposed Plan of Action
AT&SF Superfund Site

6.11	Alternative GW-3 - <i>Biological treatment (fluidized GAC bed), clarification, filtration, and disposal of ground water</i>	Page 36
6.12	Alternative GW-4 - <i>Filtration, clay adsorption, carbon adsorption and disposal of ground water</i>	Page 37
6.13	Alternative GW-5 - <i>In-Situ Steam Flushing</i>	Page 38
6.14	Alternative GW-6 - <i>In-Situ Co-Solvent/Alcohol Flushing</i>	Page 38
6.15	Alternative GW-7 - <i>In-Situ Oxidation</i>	Page 39
7.0	Comparative Analysis of Alternatives	Page 42
7.1	Comparative Analysis of Soil Alternatives	Page 42
7.1.1	Overall Protection of Human Health and the Environment	Page 42
7.1.2	Compliance with Applicable or Relevant and Appropriate Requirements	Page 43
7.1.3	Long-term Effectiveness and Permanence	Page 44
7.1.4	Reduction of Toxicity, Mobility, and Volume through Treatment	Page 45
7.1.5	Short-term Effectiveness	Page 46
7.1.6	Implementability	Page 47
7.1.7	Cost	Page 49
7.1.8	Overall	Page 49
7.2	Comparative Analysis of Ground Water Alternatives	Page 50
7.2.1	Overall Protection of Human Health and the Environment	Page 50
7.2.2	Compliance with Applicable or Relevant and Appropriate Requirements	Page 50
7.2.3	Long-term Effectiveness and Permanence	Page 50
7.2.4	Reduction of Toxicity, Mobility, and Volume through Treatment	Page 51
7.2.5	Short-term Effectiveness	Page 51
7.2.6	Implementability	Page 51
7.2.7	Cost	Page 52
7.2.8	Overall	Page 53
8.0	The Preferred Alternative	Page 55
8.1	State, City, and County Acceptance	Page 56
8.2	Community Acceptance	Page 57

List of Figures

Figure 1	AT&SF Albuquerque Superfund Site Location Map
Figure 2	Historical Features Site Map
Figure 3	Shallow Aquifer DNAPL Location Map
Figure 4	Intermediate Aquifer DNAPL Location Map
Figure 5	Santa Fe Aquifer DNAPL Location Map
Figure 6	Shallow Aquifer Contamination Map
Figure 7	Intermediate Aquifer Contamination Map
Figure 8	Santa Fe Aquifer Contamination Map

List of Photos

Photo 1	Historical 1935 Aerial Photograph
Photo 2	Historical 1951 Aerial Photograph
Photo 3	Historical 1973 Aerial Photograph
Photo 4	April 14, 2000 Aerial Photograph
Photo 5	Photos of DNAPL recovery trenches

Acronyms

ARAR	Applicable or Relevant and Appropriate Requirement
AT&SF	Atchison, Topeka and Santa Fe Railway Company
ATSDR	Agency For Toxic Substances And Disease Registry
BGS	Below Ground Surface
BNSF	The Burlington Northern and Santa Fe Railway Company
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Constituent of Concern
CTE	Central Tendency Exposure
DNAPL	Dense Non-Aqueous Phase Liquid
EPA	U. S. Environmental Protection Agency
ERA	Ecological Risk Assessment
GAC	Granulated Activated Carbon
FS	Feasibility Study
HI	Hazard Index
HQ	Hazard Quotient
LNAPL	Light Non-Aqueous Phase Liquid
LOAEL	Lowest Observable Adverse Effect Level
MCL	Maximum Contaminant Level

Proposed Plan of Action
AT&SF Superfund Site

MCLG	Maximum Contaminant Level Goals
MW	Monitoring Well
NCP	National Contingency Plan
ND	Not Detected
NMED	New Mexico Environment Department
NOAEL	No Observable Adverse Effect Level
NPL	National Priorities List
OSE	New Mexico Office of the State Engineer
O&M	Operation & Maintenance
PA	Preliminary Assessment
PAH	Polycyclic Aromatic Hydrocarbons
PCE	Tetrachloroethene
PCP	Pentachlorophenol
PRG	Preliminary Remediation Goal
PRP	Potentially Responsible Party
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
ROD	Record Of Decision
Site	AT&SF Albuquerque Superfund Site
SVE	Soil Vapor Extraction
SVOC	Semi-Volatile Organic Compound
TCDD	2,3,7,8-Tetrachlorodibenzo-p-Dioxin
TCE	Trichloroethene
TEQ	Toxicity Equivalence Factors
UST	Underground Storage Tank
UAO	Unilateral Administrative Order
UV	Ultra-Violet
VOC	Volatile Organic Compound
WWR	Waste Water Reservoir

1.0 Introduction and Community Participation

The U.S. Environmental Protection Agency (EPA) presents the following Proposed Plan for addressing hazardous substance contamination at the Atchison, Topeka and Santa Fe Railway Company (AT&SF) Superfund Site (the Site) in Albuquerque, New Mexico (CERCLIS ID # NMD980622864). The Site was added to the Superfund National Priorities List (NPL), 40 CFR Part 300, Appendix B, on December 16, 1994. This Proposed Plan addresses the Site as a whole, and proposes the following actions:

- in-situ solidification/stabilization and run-off/run-on management for soil remediation.
- The EPA is proposing an aggressive performance-based approach for remediation of the Site ground water. This performance-based approach consists of the following components:
 - Ground water restoration through pump and treat; and
 - DNAPL source removal and hot spot treatment;

This document is issued by the EPA, the lead agency for Site activity, with support from the New Mexico Environment Department (NMED). Following public review and discussion of this Proposed Plan, the EPA will make a final remedy selection that will be documented in the Record of Decision (ROD).

The purpose of the Proposed Plan is to fulfill statutory requirements pursuant to Sections 113(k)(2)(B), 117(a), and 121(f)(1)(G) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, also called Superfund), 42 U.S.C. §§ 104 (a), 9604 (a), 9613(k)(2)(B), 9617(a), and 9621(f)(1)(G), as well as the regulatory requirement of the National Oil and Hazardous Substance Pollution Contingency Plan (NCP) 40 CFR 300.430(f)(2). It also describes the alternatives analyzed, identifies the Preferred Alternative, and solicits public involvement in the selection of a remedy.

This Proposed Plan has been developed by the EPA. In developing this Proposed Plan, the EPA consulted with several Federal and state agencies including: the United States Department of the Interior (DOI), United States Fish and Wildlife Service (USF&WS), Agency for Toxic Substances and Disease Registry (ATSDR), NMED, the City of Albuquerque Environmental Health Department, and Bernalillo County.

Throughout the Site investigative and response process, the EPA and NMED have held open houses and informal meetings with community leaders and area residents to seek their input on the investigation process. These meetings have resulted in a high level of community involvement.

Proposed Plan of Action AT&SF Superfund Site

The Proposed Plan highlights key information from the RI/FS reports for the Site, but it is not a substitute for those reports. The results of the sampling activities and an assessment of the potential Site risks are presented in the RI Report. The development and evaluation of remedial alternatives to address the contamination are presented in the FS Report. For a complete source of information, please refer to these reports which are in the Administrative Record File located at the repositories listed below. The EPA encourages the public to review these documents in order to gain a more comprehensive understanding of the Site, the Superfund activities that have been conducted there, and the various alternatives that have been developed and evaluated to address the contamination at the Site. The EPA also encourages the public to participate in the decision-making process for the Site by making comments on all aspects of the Administrative Record File including the RI/FS and the Proposed Plan. The Administrative Record File is available at the following information repositories:

Albuquerque Public Library - Main Downtown Branch
510 Copper Street NW
Albuquerque, NM 87102
(505) 768-5140

Hours:

Monday - Thursday: 10:00am - 8:00pm

Friday & Saturday: 10:00am - 6:00pm

New Mexico Environment Department
Ground Water Quality Bureau
Superfund Oversight Section
1190 St. Francis Drive
Santa Fe, NM 87503
(505) 827-2911

Hours: Monday - Friday: 8:00am - 5:00pm

U.S. Environmental Protection Agency
12th Floor Library
1445 Ross Avenue
Dallas, Texas 75202-2733
(214) 665-6444

Hours: Monday - Friday: 8:00am - 5:00pm

An informal Open House was held on December 18, 2001, at 7:00 P.M. at the Jack Candelaria Community Center, located at 400 San Jose Street SE, Albuquerque, New Mexico to summarize the activities conducted as part of the RI/FS. The Proposed Plan was introduced at this meeting. Following the informal Open House, a formal public meeting will be held on February 27, 2002, at the South Broadway Cultural Center, 1025 Broadway, SE, Albuquerque, New Mexico. The public is invited to orally comment on this Proposed Plan during the public meeting. Final decisions

Proposed Plan of Action
AT&SF Superfund Site

regarding the remediation of the Site will be made only after public comments are considered. The official public comment period will begin on February 7, 2002, and end on March 9, 2002. During the public comment period, written comments, or any request for an extension of the public comment period, may be submitted to:

Greg Lyssy
Remedial Project Manager
EPA, Region 6 (6SF-LT)
1445 Ross Avenue
Dallas, Texas 75202-2733
(214) 665-8317 or toll free (800) 533-3508

For more information about the public involvement process or if you have questions about activities at the Site, please contact:

Greg Lyssy
Remedial Project Manager
EPA, Region 6 (6SF-LT)
1445 Ross Avenue
Dallas, Texas 75202-2733
(214) 665-8317 or toll free (800) 533-3508

or

Susan Morris
Project Manager
New Mexico Environment Department
1190 St. Francis Drive
Santa Fe, NM 87503
(505) 827-2890

2.0 Site Background

2.1 Site Location and Physical Description

The Burlington Northern and Santa Fe Railway Company (BNSF) currently owns the Site, which is located at 3300 Second Street, SW, in the South Valley area of Albuquerque, New Mexico. Prior to the merger of The Atchison, Topeka and Santa Fe Railway Company (AT&SF) and Burlington Northern Railway Company, this site was owned by AT&SF. The site and the surrounding area's topography is generally flat and gently slopes down toward the Rio Grande. The Rio Grande, located approximately one mile west of the site, is the nearest surface water body. The Barr Canal, which diverts water from the Rio Grande during irrigation season, is approximately one-quarter mile west of the site. The San Jose Drain, which is a storm water run-off control waterway, is approximately one-tenth of a mile east of the site. Figure 1 shows the Site location.

2.2 Site Operational History

The facility was constructed in 1908 and operated from March 1908, to January 1972. The facility used creosote and oil mixtures for treating wood products including railroad ties, bridge ties, switch ties, bridge timbers, road crossing materials, bridge piling materials, lumber, stock pen posts and fence posts. Available records indicate that the treatment process over the 65-year history remained the same, with the addition of vapor drying in 1954.

From 1914 through 1926, some materials were treated with zinc chloride followed by a creosote-petroleum mixture. Borax/boric acid was also used for some time as a flame retardant. In 1972, the facility was totally dismantled and the only physical feature remaining on-site is the wastewater reservoir/wastewater sump. Figure 2 shows the former layout of the Site. Photos 1, 2, and 3 are historical aerial photographs from 1935, 1951, and 1973. Photo 4 is an aerial photograph from April 14, 2000.

This site can be divided into five areas of potential impacts from wood treating operations.

Wood Treatment Area: The most common wood preservatives used at the facility were creosote and creosote-petroleum mixtures. Additionally, documents from the 1950s and early 1960s refer to experiments and small scale projects performed in this area using solutions containing 2% to 10% pentachlorophenol (PCP). Records also show that a vapor drying system was installed at the Site around 1954. The treatment cylinders were modified to install the vapor drying system, which involved chiefly naphtha.

Releases to this area are evident where raw materials were unloaded from railcars and stored in above ground tanks. The mechanisms for release may have been from spillage and leakage at the point of transfer from the rail car to the sump or from leakage at the underground sump and pipes

Proposed Plan of Action AT&SF Superfund Site

that transported the creosote from the unloading sump to the above ground tanks. Plant records tell of the following spills:

- 4/22/26 Leak of zinc emulsion. Loss of 6,000 pounds of zinc from a leak in an upper vat, 10,000 pounds of zinc from a leak in a pipeline, and 7,600 pounds of zinc not recovered from the emulsion;
- 1945 Loss of 18,036 gallons of 45/55 mixture of creosote and petroleum from Tank A (capacity - 95,166 gallons) located in the southeast area of the treating facility.
- 5/25/61 "A great deal of preservative on the floor, wall and pit floor" resulted from a broken valve;
- 2/11/66 An error in the recycling process of the drying agent (presumably naphtha) resulted in an unstated quantity spilled on the floor of the facility.

The degree to which the treatment cylinders released creosote is unknown. During the latter part of the plant's history, excess creosote from the treatment cylinders may have been recovered and reused. However, since the drip tracks about the treatment cylinders, any significant releases from treatment cylinders can be considered along with the drip tracks.

In addition to being a source of creosote contamination, the treatment process area is also a potential source of zinc contamination. One of the structures noted on the plant blueprint was a Zinc Sump. Other than this, there is no known information on possible sources of zinc. A review of zinc contamination in the soil shows that most of the elevated soil concentrations occur in the treatment process area. The drip tracks also show some impact by zinc.

Drip Tracks: Tram tracks used for moving wood to and from the treatment cylinders are referred to as drip tracks. The standard operating practice in the wood treatment plant was to hold the treated lumber for a period of 24 hours in the immediate vicinity of the treatment cylinder. Based upon this operating practice, it is speculated that the tram tracks area, and areas just outside the cylinders, were used as drip track areas.

Tie Storage Area: This area was where the treated ties were stored and allowed to dry. Releases to this area would be restricted largely to drippings from treated products. With the advent of vapor drying in 1953, the amount of drippings was substantially reduced. However, creosote drippings may accumulate at locations where ties are repeatedly stacked, but the accumulations tend to dry out between loads.

Wastewater Reservoir: Condensate water from the air compressor and surplus water from the oil/water separator tanks in the treatment building were discharged to the wastewater reservoir. Also,

Proposed Plan of Action AT&SF Superfund Site

sap water derived from wood before treating with creosote was discharged to this reservoir. A sump located in the northwestern corner of the reservoir, which is separated from the reservoir by an earthen berm, handled domestic sewage from on-site company housing.

Wastewater Discharge Ditch: Overflow from the wastewater reservoir was handled by the sump, which discharged to the Barilas Ditch bounding the west side of the property. The facility records show that plant wastewater was discharged in one of two fashions. Water that was considered clean (i.e., boiler blow-down, surplus vacuum pump water, and cooling jacket water) was discharged to the clear-water ditch bounding the south side of the property. Other wastewater, including sap water, air compressor condensate and surplus from the oil/water separator, was discharged to the wastewater reservoir.

From 1972, when the plant was dismantled, to 1982, no activity took place at the plant. In 1982, portions of the property were leased to Bredero Price, Inc., which operated a pipe storage and coating facility for approximately one year. The pipe coating operation was of limited duration and none of the samples analyzed and reported suggest that the pipe coating operation had an impact on the Site. Bredero's storage needs prompted the consolidation of the plant's demolition debris. Much of the plant debris was pushed into the east end of the wastewater reservoir. Other debris, consisting largely of soil and uprooted trees, was bulldozed into a large pile at the southeast end of the plant. The debris in the wastewater reservoir was removed in 1990.

In 1987, an auto unloading facility was built north of the Site outside of the treatment area. Adjacent to the auto facility is an intermodal ramp used for unloading and loading containers and trailers on railcars.

2.3 Summary of Site Investigations

The first three phases of the Site Investigation were carried out from January 1987 through October 1988. In October 1988, a final report titled *Site Investigation Report, The Atchison, Topeka and Santa Fe Railway Company Former Wood Treating Facility, Albuquerque, New Mexico* was prepared and submitted to the NMED. The primary emphasis of the first three phases was the wastewater reservoir area since it still contained creosote contaminated material and was considered a primary source of contamination. The first three phases of the site investigation accomplished the following:

- Completion of three exploratory soil borings ranging in depth from 40 to 102 feet;
- Analysis of 55 soil samples for organic and inorganic constituents;
- Installation of 18 piezometers ranging in depth from 12 to 20 feet;
- Completion of eight cone penetrometer holes ranging in depth from 28 to 51 feet;
- Installation of 14 monitor wells: seven shallow monitor wells ranging in depth from 19.5 to 24 feet and seven intermediate depth monitor wells ranging in depth from 57 to 82.5 feet;
- Analysis of 27 ground water samples for organic and inorganic constituents;

Proposed Plan of Action AT&SF Superfund Site

- Completion of three rounds of water level measurements; and
- Survey of 788 private wells within a 4-mile radius.

The purpose of the Phase I investigation was to define the shallow geology and to determine if chemical constituents typical of creosote were present in the shallow ground water underlying the site. This phase of the investigation revealed that the clay layer separating the Shallow and Intermediate Aquifers of the Rio Grande Alluvium did not extend uniformly over the entire site. In addition, chemical constituents typically found in creosote were detected in the waters of the Shallow Aquifer.

The Phase II investigation was designed to determine if creosote chemicals were present in the Intermediate Aquifer, and to further define the area over which the clay layer was missing. During this investigation it was determined that chemical constituents had penetrated the clay layer, and were found in the Intermediate Aquifer.

The Phase III investigation was designed to further define the vertical and horizontal extent of creosote contaminants in soils and ground water. Soil samples were submitted for chemical analysis for volatile organics, semi-volatile organics, anions, and metals.

The Phase IV Site Investigation was conducted in February 1990 to define the extent of creosote constituents in the subsurface soils south of the Site. During this investigation, the following was accomplished:

- Completion of geophysical survey of the field south of the Site;
- Installation of four monitor well nests consisting of two wells per nest;
- Chemical analysis of soil samples for characterization purposes; and
- Analysis of ground water samples.

The Phase V Site Investigation is the RI portion of the overall RI/FS program, conducted under CERCLA. The Phase V investigation was designed to investigate other sources, such as the treatment process area, drip tracks and tie storage areas, and to ensure that the Site was fully characterized. The Phase V investigation included:

- Source area investigations;
- Dense non-aqueous phase liquid (DNAPL) investigation;
- Tie storage area investigation;
- Underground Storage Tank (UST) investigations;
- Ditch investigation;
- Deep Aquifer investigation;
- Private well sampling; and
- Aquifer tests.

Proposed Plan of Action

AT&SF Superfund Site

The Phase V wastewater impoundment investigation consisted of six soil borings and was conducted in July 1999 as a follow-up to the wastewater reservoir sludge removal action performed in April 1999. The purpose of this investigation was to determine the vertical extent of DNAPL beneath the old impoundment area. Soil samples were collected continuously from the ground surface to the base of the Shallow Aquifer, approximately 20 feet below ground surface (bgs). Samples from the Intermediate Aquifer were taken every five feet and were described for lithology and visible creosote. Near the base of the Intermediate Aquifer, samples were collected continuously to determine the location of the Santa Fe Aquifer. The ground water in the Santa Fe Aquifer is presently the only source of drinking water for the City of Albuquerque. Extreme care was taken during the field investigation to ensure that DNAPL creosote was not introduced into the Santa Fe Aquifer. If DNAPL was not observed near the base of the Intermediate Aquifer in that boring, drilling continued into the Santa Fe Aquifer for approximately 10 to 15 feet. Ground water sampling was also conducted as part of this investigation.

During the Phase V Site Investigation, sample collection generally started at a depth of five feet below the ground surface. Surface soil samples (0-6") were not collected because there was no visible evidence of creosote impact on the ground surface, and much of the top soil at the facility is fill material put in place either following the installation of vapor drying (when drippage was dramatically reduced), or after the treatment plant was dismantled. In addition, the top one to two feet of soil was disturbed by Bredero Price, Inc., which occupied the site after BNSF's wood treating operation had ceased. However, the Ecological Risk Assessment required that additional surface soils be sampled. In response to that requirement, 17 surface soil samples were collected from the tie treatment and drip track areas in October 1999.

2.4 Previous Response Actions

In July and August of 1990, BNSF removed and disposed of approximately 8,250 tons of creosote-tainted debris. This debris was comprised of plant demolition wreckage that had been placed into the east end of the wastewater reservoir by Bredero Price, Inc. Due to contact with the creosote in the reservoir, much of the debris was tainted with creosote. Approximately 45,000 square feet of the wastewater reservoir was excavated to a depth of 2 to 5 feet.

Two areas with total SVOC concentrations above 41.1 mg/kg were excavated from the tie storage area in 1996. The excavated area was backfilled with clean soil and confirmation testing was performed to ensure that the contaminated soil had been excavated.

In April 1999, sludge and process residue from the wastewater reservoir (WWR) was excavated from the Site. This removal action was in response to a Unilateral Administrative Order (UAO) for a Removal Response Action issued by the EPA, which specifically called for BNSF to remove process residues located within the old wastewater reservoir. Approximately 1,100 cubic yards of process residues and highly contaminated soil were in the WWR. The UAO required the removal of process residues, plus a minimum of 6 inches of underlying soil. Because of the fluid nature of this material

Proposed Plan of Action

AT&SF Superfund Site

and a lack of a well-defined contact between process residues and soil, up to 2 feet of underlying soil was removed. At locations, upon instructions from EPA, excavations were as deep as 6 feet. The removal action was completed on April 30, 1999. A total of approximately 83 gondola cars (approximately 6,012 tons) were filled and transported by rail to Safety Kleen Inc.'s Lone Mountain (RCRA Subtitle C) Landfill in Waynoka, Oklahoma for disposal.

In 1999, three recovery trenches were installed in the WWR to collect DNAPL through a gravity feed system. In 2000, five recovery pumps were installed to extract DNAPL from the Shallow and Intermediate Aquifers. These pumps were installed in monitoring wells MW-2B, MW-18A, MW-19B, MW-22B and MW-23B. These recovery wells have been actively pumping DNAPL from the aquifer since 2000.

3.0 Site Characteristics

3.1 Physical Site Characteristics

The site and the surrounding area's topography is generally flat and gently slopes down toward the Rio Grande. The Rio Grande, located approximately one mile west of the site, is the nearest surface water body. The Barr Canal, which diverts water from the Rio Grande during irrigation season, is approximately one-quarter mile west of the site. The San Jose Drain, which is a storm water run-off control waterway, is approximately one-tenth of a mile east of the site.

The climate in the Site vicinity is semi-arid and characterized by sunny days and low humidity. The average annual total precipitation is between 8 and 9 inches with a potential evapo-transpiration rate computed to be greater than 60 inches. Most of the rainfall is from storms that occur from July to September. Temperatures vary from an average of 90 degrees Fahrenheit in the summer months, to an average of 49 degrees Fahrenheit in the winter months.

3.2 Current and Anticipated Future Land and Ground Water Use

Current land use is predominantly industrial and agricultural. To the immediate south and east of the site are agricultural fields and to the west, north, and northeast are industrial complexes. The agricultural fields are currently zoned for industrial use. There are small residential areas scattered to the northwest, southwest and south. The closest residential area is about 0.5 miles to the southwest and a single residence (mobile home) is located about 600 feet west of the site. This residential area is currently zoned as industrial. Two major residential areas are located about 2 miles north and 1.5 miles south of the site. Major population centers are located either west of the Rio Grande, north of Woodward drive or east of Interstate 25.

Data obtained during the RI/FS indicate that approximately 700 residences are located within a one-mile radius of the site and approximately 44,000 residences are located within a four-mile radius. Future on-site land use is anticipated to be industrial or commercial. Future off-site land use is anticipated to be residential, industrial, or commercial.

Contaminated ground water at the Site is not currently used for drinking water purposes. The ground water in the Santa Fe Formation is presently the only source of drinking water for the City of Albuquerque. A total of 91 municipal wells provide water to the City of Albuquerque. No municipal supply wells or private drinking water wells are located within the current boundaries of the Site. The municipal supply wells service approximately 400,000 individuals. There are six municipal supply wells located within a two-mile radius of the site. These wells service approximately 9,000 individuals.

Future use of the Site ground water may involve drinking water uses to meet supply demand as the City of Albuquerque and the surrounding area continue to grow. In addition, because private and

municipal supply wells are located directly down-gradient of the Site contamination, migration of the plume might impact drinking water wells in the future.

3.3 Site Hydrogeology

The site is located in the inner Rio Grande Valley, which is incised into the sedimentary basin fill of the Albuquerque basin. The sedimentary basin fill consists largely of the Santa Fe Formation with some overlying recent deposits represented by the Rio Grande Alluvium. The Santa Fe Formation, which is divided into three parts (upper, middle and lower) is approximately 4,750 feet thick in the area. The upper Santa Fe Formation is estimated to be about 650 feet thick in the vicinity of the site and flows in a northerly direction. This is probably in response to ground water withdrawn from the San Jose Municipal Well Field located about 2 miles north of the site.

At the site, the Rio Grande Alluvium is about 53 to 82 feet thick and consists of two water-bearing zones: the Shallow Aquifer and the Intermediate Aquifer. A discontinuous silty clay layer separates these two aquifers. At the site, ground water flow is generally in the southeast direction.

For the purposes of delineating the vertical extent of contamination, ground water (aquifer) zones are based on depth bgs. The aquifer zones are based primarily on depths of existing monitoring and water supply wells. These aquifer zones are:

- **Shallow (S)** - The shallow Aquifer extends to an average depth of 20 feet below ground surface (bgs).
- **Intermediate (I)** - The Intermediate Aquifer extends to an average depth of 60 feet bgs.
- **Santa Fe Formation (D)** - The Santa Fe Formation Aquifer starts at approximately 60 feet bgs, and extends for several thousand feet below the Site.

An additional term in describing the contamination in the aquifer is a “**hot spot**.” For the purposes of this Site, a hot spot is defined as an area having ground water contamination with relatively high concentrations (at least two orders of magnitude¹ above maximum contaminant levels (MCLs)) observed consistently (during at least three sampling periods).

3.4 Nature and Extent of Contamination

Most of the organic contamination found at the site occurs as a dense non-aqueous phase liquid (DNAPL) with organic compounds that slowly dissolve into the ground water followed by some preferential sorption to particles in the aquifer matrix. The RI report indicates that DNAPLs are present in the subsurface as either “free phase” or “residual phase.” The free phase is that portion of the DNAPL that can continue to migrate and sink into the aquifer, whereas the residual phase is

¹An order of magnitude is a multiple of ten.

Proposed Plan of Action

AT&SF Superfund Site

that portion of the DNAPL that is trapped in pore spaces by capillary forces and cannot generally migrate as a separate liquid. Both occurrences of the DNAPL act as continuing sources of contamination to ground water. It is estimated that there are approximately 70,000 gallons of DNAPL at the Site.

The ground water contamination at this site has two different components: the aqueous contaminant plume and the DNAPL plume. The aqueous contaminant plume includes those portions of the site where only dissolved contaminants are present in ground water. The DNAPL zone includes those portions of the site where immiscible liquids are present in the subsurface, as either free phase or residual phase compounds.

Ground water contamination at the site was found to be in the two aquifers comprised of Rio Grande Alluvium as well as the upper Santa Fe Formation. DNAPL has been found down to depths of 65 feet. The Shallow Aquifer extends to an average depth of 20 feet and has an average thickness of 4 feet. The Intermediate Aquifer extends to an average depth of around 60 feet and has an approximate thickness of 25 feet and is separated from the Shallow Aquifer by a silty clay layer about 13 feet thick. The Santa Fe Formation Aquifer starts at around 60 feet and extends for several thousand feet below the Site.

Investigation of the shallow unsaturated soil has shown that ground water contamination can be traced back to four source areas within the Area of Contamination (AOC):

- The wastewater reservoir;
- The weighing station for treated ties;
- The above ground storage tanks; and
- The tank car unloading facility.

Soil Contamination

As stated previously, soil samples were collected during the numerous investigations at the Site. Specific details on soil sampling, analytical methods and data evaluation are provided in the RI report. As expected, the nature of contamination across the site is fairly uniform. While the concentration of contaminants at different locations within the impacted area varies, the list of contaminants is fairly typical of a wood treating operation. These contaminants consist of Polynuclear Aromatic Hydrocarbons (PAHs) semi-volatiles. A complete list of the chemicals of concern is presented in Section 4.1 of this plan.

Creosote constituent concentrations in unsaturated zone soils of the wastewater reservoir areas have been as high as 13,250 mg/kg, prior to the removal activities in 1999. In the treatment process area, concentrations are as high as 1,356 mg/kg and in the drip track area, concentrations are as high as 7,000 mg/kg. These maximum concentrations are typically near points of release e.g., the tank car unloading area, the above ground storage tanks and the weighing station for treated ties. More

Proposed Plan of Action

AT&SF Superfund Site

typically, the concentrations in these three areas are in the range of 100 to 1,000 mg/kg. With depth, the boundaries of impacted soil from these sources overlap and merge.

Carcinogenic PAHs were found at concentrations above 8 mg/kg Benzo(a)pyrene (BAP) equivalents in unsaturated soils of the wastewater reservoir and the drip track area, but not of the treatment process area. The Human Health Risk Assessment identified 8 mg/kg BAP equivalents as a preliminary health based screening criteria for carcinogenic PAHs in soils. The 8 mg/kg BAP equivalents is based upon a industrial scenario through soil ingestion. In the wastewater reservoir, carcinogenic PAHs are as high as 92 mg/kg BAP equivalents, and in the drip track area, they are as high as 70 mg/kg and possibly 269 mg/kg BAP equivalents.

Soil samples with elevated concentrations of semivolatile organics occur at discharge points in the clear-water ditch and in the Barelás Ditch. However, carcinogenic PAHs are negligible in ditch samples. Naphthalene and 2-methylnaphthalene occur in a number of samples, but at concentrations of 1 mg/kg or less.

Dioxin and furan concentrations from soil samples were evaluated as an equivalent 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (2,3,7,8-TCDD) concentration, which is the most toxic congener of dioxins and furans. Only one sample had a detectable presence of 2,3,7,8-TCDD, with a concentration of 1.005 ng/kg. All other samples had only the less toxic congeners detected in them. The TCDD-TEQ concentrations for soil samples ranged from 1.19 ng/kg to 94.1 ng/kg. The elevated TCDD-TEQ concentrations were located in the wastewater reservoir area and the treatment process/drip track area. The sample with 2,3,7,8-TCDD was located in the wastewater reservoir area that had the removal action in 1999. As such, Dioxin is not considered a COC at this Site.

Aquifer Soil/DNAPL Contamination

A significant thickness of DNAPL has been measured in the DNAPL recovery wells. The DNAPL thickness, as recorded in 2000, ranged from 1.0 to 8.8 feet. The occurrence of DNAPL in wells in both of the Rio Grande Alluvial aquifers indicates the clay layer is discontinuous between the Shallow and Intermediate Aquifers. Well MW-19B is located in an area where a gap occurs; this gap indicates a pathway from the original source downward through the Shallow Aquifer to the Intermediate Aquifer. In contrast, MW-18A is located in an area where the clay is intact. The clay layer is also near the weighing station for the treated ties, which was a significant source of DNAPL. While DNAPL has been measured in MW-18A in the Shallow Aquifer, it has not appeared in MW-18B in the Intermediate Aquifer; hence, for the treatment plant and drip track areas, the clay has been a somewhat effective barrier to the downward migration of DNAPL. DNAPL is also observed in the sand layer of the Intermediate Aquifer beneath the wastewater reservoir. Figures 3, 4, and 5 show the location of the DNAPL in the three aquifers.

Contaminant fate and transport of the plume at the site was detailed in the RI Report. Additionally, an evaluation of ground water modeling performed at the Site is also discussed in that report. Photo

Proposed Plan of Action

AT&SF Superfund Site

5 shows some of the DNAPL at the Site. The following discussion of the contaminated ground water plume in the Shallow, Intermediate, and Santa Fe Aquifers is based on the results of the ground water monitoring that was conducted in 2000. These data represent typical and current site conditions.

Shallow Aquifer

The contaminated ground water plume in the Shallow Aquifer has a maximum width of approximately 1,500 feet in the east-west direction and a maximum length of approximately 1,800 feet in the northeast-southwest direction. The existence of two plume centers is attributed to two different sources within the AOC: the wastewater reservoir and the wood treatment facility. Figure 6 shows the dissolved contamination in the Shallow Aquifer.

During the 2000 ground water monitoring performed at the site, benzene was the only volatile organic compound (VOC) that exceeded the federal maximum contaminant level (MCL) and the New Mexico Water Quality Control Commission (NMWQCC) regulations. Benzene was detected in MW-3A at a concentration of 70.9 µg/L. VOC concentrations in other shallow wells were either not detected, or were below federal and state limits.

For semi-volatile organic constituents (SVOCs), benzo(a)pyrene, naphthalene and 2-methylnaphthalene exceeded federal or state standards during the 2000 ground water monitoring event. Benzo(a)pyrene exceeded the standard in MW-12A, and the sum of naphthalene and 2-methylnaphthalene exceeded the standard in MW-3A and MW-8A. SVOC concentrations in other shallow wells were either not detected, or were below federal and state limits.

Intermediate Aquifer

The contaminated ground water plume in the Intermediate Aquifer is an irregular elliptical shape with a “finger” of low concentration SVOCs extending west of the fenced boundary. The dimension of the plume, with the exception of the finger, has a maximum width of 1,300 feet in the east-west direction and a maximum length of 1,100 feet in the north-south direction. The two focal points of the plume is attributed to two different sources: the wastewater reservoir and the wood treatment facility. Figure 7 shows the dissolved contamination in the Intermediate Aquifer.

During the 2000 ground water monitoring, VOCs were not detected in excess of the federal and state MCLs in the Intermediate Aquifer. For SVOCs, naphthalene and 2-methylnaphthalene exceeded federal or state standards.

Santa Fe Formation Aquifer

Proposed Plan of Action

AT&SF Superfund Site

The estimated horizontal extent of contamination occurs mainly beneath the wastewater reservoir and the wood treatment area. Only the top of the Santa Fe Formation Aquifer is impacted. Figure 8 shows the dissolved contamination in the Santa Fe Aquifer.

During the 2000 ground water monitoring, VOCs were not detected in excess of the federal and state MCLs in the Santa Fe Aquifer. For SVOCs, naphthalene and 2-methylnaphthalene exceeded federal or state standards. The sum of naphthalene and 2-methylnaphthalene exceeded the standard in MW-26C. No SVOCs were detected in the Santa Fe Aquifer wells that are screened deeper than 100 feet below the ground surface. Samples collected from the upper part of the Santa Fe Aquifer indicate evidence of dissolved DNAPL constituents. Wells MW-25C, MW-26-C, MW-27C, MW-28CU and MW-29CU showed total SVOC concentrations from 0.413 µg/L to 679.35 µg/L.

3.5 Principal and Low-Level Threat Wastes

Principal threat wastes are wastes that cannot be reliably controlled in place, such as liquids, highly mobile materials (e.g., solvents), DNAPLs, and high concentrations of toxic compounds (e.g., several orders of magnitude above levels that allow for unrestricted use and unlimited exposure). The EPA expects that treatment will be the preferred means to address the principal threats posed by a site, wherever practicable. Low-level threat wastes are those source materials that generally can be reliably contained and that contain contaminant concentrations not greatly above the acceptable levels. Examples of low-level threat wastes include non-mobile contaminated source material of low toxicity and low concentrations of low toxicity source material. Principal threat and low-level threat wastes associated with the Site are as follows:

Soil

Based on the information that the EPA has, VOCs and SVOCs in soils at the Site are not a principal threat because concentrations of these COCs in the soil are not several orders of magnitude above levels that allow for unrestricted soil use and unlimited exposure, and because the toxicity is low. However, this material is a low-level, but significant threat, because the concentrations in the soil are high enough to contaminate ground water through leaching. This could potentially lead to ground water contamination that exceeds MCLs.

Ground water

The EPA considers the VOCs and SVOCs (including benzene, benzo(a)pyrene, naphthalene and 2-methylnaphthalene, and Benzo(a)pyrene) in ground water at the Site to be a principal threat waste because contaminant concentrations are substantially above concentration levels that pose an unacceptable risk to human health, if humans were exposed to the ground water. The contamination is in an aquifer that is the only source of drinking water supply for the City of Albuquerque. It should be noted that the contamination has not yet reached any of the municipal supply wells or

Proposed Plan of Action

AT&SF Superfund Site

private water wells. However, there is the possibility, that if unaddressed, contamination from the Site may reach municipal supply wells for the City of Albuquerque and private water wells.

DNAPL

The EPA considers the DNAPL at the Site to be a principal threat waste because contaminant concentrations are substantially above concentration levels that pose an unacceptable risk to human health. In addition, the DNAPL will continue to be a source of ground water contamination unless it is removed or immobilized. The DNAPL creosote is in the soil and ground water at depths down to 65 feet. The DNAPL is in the very top of the Santa Fe Formation Aquifer. The Santa Fe Formation Aquifer is the only source of drinking water supply for the City of Albuquerque. It should be noted that the DNAPL contamination has not yet reached any of the municipal supply wells or private water wells. However, there is the possibility, that if unaddressed, contamination from the Site may reach municipal supply wells for the City of Albuquerque and private water wells.

3.6 Scope and Role of Response Action

The EPA expects that the Site contamination will be addressed as one operable unit through the remedy selected in the Record of Decision (ROD) which will be issued following this Proposed Plan. (An operable unit is a discrete action that comprises an incremental step toward comprehensively addressing Site contamination.) That is, the response action, which will be detailed in the Site ROD, will address both the principal threat wastes (e.g., the DNAPL and VOCs and SVOCs in ground water) and the low-level, but significant, threat wastes (the e.g., the VOCs and SVOCs in soils).

4.0 Summary of Site Risks

4.1 Contaminants of Concern (COCs)

The following constituents are considered to be COCs at the Site:

Constituent	Ground Water COC	Soil COC
Zinc		U
Benzene	U	
Benz(a)anthracene	U	U
Benz(a)pyrene	U	U
Benzo(b)fluoranthene	U	U
Benzo(k)fluoranthene	U	U
Bis(2-ethylhexyl) phthalate	U	
Carbazole	U	
Chrysene	U	
Dibenz(a,h)anthracene	U	U
Dibenzofuran	U	U
Indeno(1,2,3-c,d)pyrene	U	U
2-Methylnaphthalene	U	U
Naphthalene	U	U
Total Semi-Volatiles	U	U
BAP Equivalent	U	U

These COCs are chemicals that pose a carcinogenic risk to human health greater than 1 in 1,000,000 (1×10^{-6}), have a noncarcinogenic hazard index (HI) greater than ($>$)1², or are found in Site ground water at concentrations that exceed MCLs.

²For an explanation of Hazard Index, see Section 4.4 (Toxicity Assessment).

4.2 Land and Ground Water Use Assumptions

Future land use is expected to be similar to current land use, which is chiefly industrial, agricultural, and residential. To the immediate south and east of the site are agricultural fields and to the west, north, and northeast are industrial complexes. The agricultural fields are zoned for industrial use. There are small residential areas scattered to the northwest, southwest and south. The closest residential area is about 0.5 miles to the southwest and a single residence (mobile home) is located about 600 feet west of the site. This area is currently zoned as industrial. Two major residential areas are located about 2 miles north and 1.5 miles south of the site. Major population centers are located either west of the Rio Grande, north of Woodward Drive or east of Interstate 25.

Contaminated ground water at the Site is not currently used as a drinking water supply. However, the ground water in the Santa Fe Formation is presently the only source of drinking water for the City of Albuquerque. There are no municipal supply wells or private drinking water wells located within the current boundaries of the Site, but there are six municipal supply wells located within two miles of the Site. The closest private water well is located 400 feet west of the Site.

Future use of the Site ground water may involve drinking water use to meet supply demand as the City of Albuquerque and the surrounding area continue to grow. In addition, because private and municipal supply wells are located directly down-gradient of the Site contamination, migration of the ground water contaminant plume might impact drinking water wells in the future.

4.3 Potentially Exposed Populations

The Baseline Risk Assessment identified primary contaminant sources, contaminant release mechanisms, exposure pathways, and receptors for the COCs. The potentially exposed individuals evaluated were based on current and potential future land use and most probable current and future activities at the site, as described in Section 4.2. During the risk assessment process, it was determined that an industrial on-site exposure scenario would be utilized, and a residential off-site exposure scenario would be used.

Potentially exposed individuals and their associated soil exposure pathways include:

- Current off-site resident adult and child exposed to soil via inhalation, dermal contact and ingestion;
- Future off-site resident adult and child exposed to soil via inhalation, dermal contact, and ingestion;
- Current on-site workers exposed to the soil via inhalation, ingestion, and dermal contact;
- Future on-site workers exposed to the soil via inhalation, ingestion, and dermal contact; and
- Future on-site excavation/utility workers exposed to the soil via inhalation and dermal contact.

Potentially exposed individuals and their associated **ground water** exposure pathways include:

- Future off-site resident adult and child exposed to ground water via inhalation, ingestion and dermal contact; and
- Future on-site workers exposed to the ground water via inhalation, ingestion and dermal contact.

4.4 Toxicity Assessment

Site contaminants were assessed for carcinogenicity and for non-carcinogenic systemic toxicity. For carcinogens, risks are generally expressed as the incremental probability of an individual's developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated from the following equation:

$$\text{Risk} = \text{CDI} \times \text{SF}$$

where: risk = a unitless probability (e.g., 2×10^{-5}) of an individual's developing cancer
CDI = Chronic daily intake averaged over 70 years (mg/kg-day)
SF = slope factor, expressed as (mg/kg-day)⁻¹.

These risks are probabilities that usually are expressed in scientific notation (e.g., 1×10^{-6}). An excess lifetime cancer of 1×10^{-6} indicates that an individual experiencing the Reasonable Maximum Exposure (RME) estimate has a 1 in a 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual's developing cancer from all other causes has been estimated to be as high as one in three. EPA's generally acceptable risk range for site-related exposures is 10^{-4} to 10^{-6} .

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., life-time) with a reference dose (RfD) derived for a similar exposure period. An RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ less than 1 indicates that an individual's dose of a single contaminant is less than the RfD, and that toxic noncarcinogenic effects from that chemical are unlikely. The Hazard Index (HI) is generated by adding the HQs for all chemical(s) of concern that affect that same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. An HI less than 1 indicates that, based on the sum of all HQ's from different contaminants and exposure routes, toxic noncarcinogenic effects from all contaminants are unlikely. An HI greater than 1 indicates that site-related exposures may present a risk to human health.

The HQ is calculated as follows:

$$\text{Non-cancer HQ} = \text{CDI/RfD}$$

where:

CDI = Chronic daily intake

RfD = Reference dose.

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or short-term).

4.5 Human Health Risk Characterization

Risk estimates were calculated for future land use scenarios for hypothetical human receptors at the Site. Cancer risks were estimated as the probability of an individual developing cancer over a lifetime as a result of exposure to the Site's carcinogenic contaminants. Toxicity risk estimates for noncarcinogenic toxic chemicals are presented for COCs. The potential for noncarcinogenic hazards due to potential exposures to chemicals was evaluated by calculating an HI for the COCs at the Site. The Baseline Risk Assessment shows the detailed calculation of risk.

The Baseline Risk Assessment organized the types of risk at the Site according to various exposure scenarios. Each exposure scenario specifies the type of human receptor (e.g., child resident, adult industrial worker), the exposure pathway (e.g., inhalation, ingestion) and the COC. If a contaminant or exposure scenario is found to produce a risk which will require a remedial action (based on either the carcinogenic risk or the HI) that contaminant or exposure scenario is said to "drive the risk" or "drive" the need for action. A remediation goal is set for site-related contaminants that drive risk. The following exposure scenarios are driving the need for action at the Site (all risks are expressed as Reasonable Maximum Exposure or RME).

4.6 Ecological Risk Characterization

An ecological risk assessment (ERA) was conducted based on the results of a screening ERA and surface soil and biota tissue sampling results collected from the site. Important ecological receptors at the site included soil vertebrates, avian and mammalian herbivores, insectivores/omnivores, and carnivores. To support the ERA, a defined surface soil sampling program was conducted to secure the required data. Pathways for the receptors are ingestion of contaminants detected in surface soils and ingestion of vegetation, invertebrates, and small mammals that are in contact with the surface soils at the site.

Mean and maximum exposure doses to soil invertebrates and six indicator species were estimated based on models previously developed in the screening ecological risk assessment and surface soil sampling data. The selected indicator species include: (1) prairie vole (mammalian herbivore); (2) Canada goose (avian herbivore); (3) short-tailed shrew (mammalian insectivore/omnivore); (4)

Proposed Plan of Action

AT&SF Superfund Site

American robin (avian omnivore); (5) red fox (mammalian carnivore); and (6) red-tailed hawk (avian carnivore). No Observable Adverse Effect Level (NOAEL) and Lowest Observable Adverse Effect Level (LOAEL) chronic toxicity reference values for avian and mammalian receptors were derived from the literature and compared with the mean and maximum estimated exposure doses received by the selected indicator species.

The maximum estimated exposure dose received by the prairie vole, Canada goose, red fox and red-tailed hawk are less than their respective chronic NOAEL toxicity values. It is unlikely that these indicator species are at risk from detected concentrations of contaminants at the site.

The estimated maximum polycyclic aromatic hydrocarbons (PAH) exposure doses (both low and high molecular weight PAHs) received by the short-tailed shrew exceed chronic NOAEL benchmarks, but are less than the chronic LOAEL benchmarks. PAH exposure to the shrew is primarily from the ingestion of contaminated surface soils. Because the estimated PAH exposure doses exceed the chronic NOAEL toxicity value, the shrew is potentially at risk from the detected concentrations of PAHs in the surface soils of the site. However, there is considerable uncertainty in this potential risk as the chronic NOAEL was derived by reducing the LOAEL by an order of magnitude.

Estimated mean and maximum exposure doses of zinc received by the American robin exceed chronic NOAEL and LOAEL toxicity values. The mean exposure dose of the robin is approximately two times greater than its LOAEL toxicity value that is associated with a reduction in egg hatchability. Therefore, there is a potential for detected zinc concentrations within site invertebrates and vegetation to result in adverse effects to avian insectivores/omnivores.

Ecologically protective soil concentrations were derived for those contaminants that have mean hazard quotients above unity for any of the measurement receptors. These risk-based clean-up levels are detailed in Section 2.0 of the Soil Feasibility Study.

4.7 Basis for Action

The risks detailed in this section show a threat to future adult residents and workers, and current and future off-site residents who could come into contact with Site ground water, DNAPL, and/or soil. In addition, there is a threat to current and future ecological receptors. It is the EPA's current judgment that the Preferred Alternative identified in Section 6 of this Proposed Plan, or one of the other active measures considered in the Proposed Plan, is necessary to protect the public health, welfare, and the environment from actual or threatened releases of hazardous substances into the environment.

5.0 Remedial Action Objectives and Goals

5.1 Remedial Action Objectives

Under the provisions of the National Contingency Plan (NCP) (40 CFR Part 300), the lead agency involved in a Remedial Action (in this case, the lead agency is the EPA) is required to establish remedial action objectives (RAOs) for protecting human health and the environment. RAOs specify the contaminants and media of concern, potential exposure pathways, and preliminary remediation goals (NCP, 1990). Remediation goals are concentrations of contaminants for each exposure route that are protective of human health and the environment.

The RAOs for **ground water** are:

- Prevent human ingestion, inhalation, or dermal contact with ground water that contain Site related COCs at concentrations which exceed the corresponding Maximum Contaminant Level Goals (MCLGs) established under the Safe Drinking Water Act (SDWA). This applies for COCs that have MCLGs set above zero. Alternatively, prevent human ingestion or inhalation of ground water containing Safe Drinking Water Act Maximum Contaminant Levels of these COCs when the corresponding Maximum Contaminant Level Goals are zero.
- Restore the ground water at the Site such that it contains concentrations of the COCs less than the Maximum Contaminant Levels or non-zero Maximum Contaminant Level Goals, as applicable.
- Prevent the DNAPL, the principal threat waste at the Site, from causing concentrations of COCs in ground water to exceed the Maximum Contaminant Levels or Maximum Contaminant Level Goals.
- Prevent the transport of COCs from ground water to surface water in concentrations that may result in exceedances of the Applicable or Relevant and Appropriate Requirements (ARARs) in the receiving surface water body.

The RAOs for **soil** are:

- Prevent the ground water from being impacted above MCLs through transport of COCs from the unsaturated zone.
- Prevent storm water runoff from areas that exceed any remediation goals.
- Prevent the inhalation, ingestion, and dermal contact of contaminated soils for future on-site commercial/industrial/utility workers exposed to the soil.

Proposed Plan of Action AT&SF Superfund Site

- Prevent contaminated soils from becoming airborne and leaving the Site as dust.
- Prevent ecological receptors from being adversely impacted by on-site contamination.

5.2 Basis for Selection of Remediation Goals

A Preliminary Remediation Goal (PRG) is the allowable concentration of a contaminant which may remain in a specific medium (such as soil or ground water) at a site after implementation of the Record of Decision (ROD) through the Remedial Action. The PRGs for the Site COCs in ground water are:

Constituent of Concern	Ground Water Preliminary Remediation Goal
Benzene	5.0 µg/l (MCL)
Benz(a)anthracene	0.1 µg/l
Benz(a)pyrene	0.2 µg/l (MCL)
Benzo(b)fluoranthene	0.2 µg/l
Benzo(k)fluoranthene	0.2 µg/l
Bis(2-ethylhexyl) phthalate	6.0 µg/l (MCL)
Carbazole	0.0031 µg/l
Chrysene	0.2 µg/l
Dibenz(a,h)anthracene	0.3 µg/l
Dibenzofuran	15 µg/l
Indeno(1,2,3-c,d)pyrene	0.4 µg/l
Total Naphthalene	30 µg/l
Total Semi-Volatiles	82.6 µg/l
BAP Equivalent	0.572 µg/l

Where no ARARs exist or where ARARs may not be sufficiently protective, the NCP prescribes methods for selection of remediation goals. Since there are no chemical-specific ARARs for Site soils, remediation goals for soil were selected based on guidance documents outlining scientific methods to determine protective goals. The remediation goals for soil are set at a level such that, if remediation goals are met, ground water cannot become impacted above the MCLs for these compounds through contaminant migration from soils. In addition, if the remediation goals are met,

Proposed Plan of Action
AT&SF Superfund Site

ecological receptors will not be adversely impacted by on-site contamination. The remediation goals for the Site COCs in soil are:

Constituent of Concern	Soil Preliminary Remediation Goal
Zinc	200 mg/kg
Benz(a)anthracene	13 mg/kg
Benz(a)pyrene	1.3 mg/kg
Benzo(b)fluoranthene	13 mg/kg
Benzo(k)fluoranthene	130 mg/kg
Dibenz(a,h)anthracene	1.3 mg/kg
Dibenzofuran	87 mg/kg
Indeno(1,2,3-c,d)pyrene	13 mg/kg
2-Methylnaphthalene	28 mg/kg
Naphthalene	14 mg/kg
Total Semi-Volatiles	300 mg/kg
BAP Equivalent	7.8 mg/kg

The Remedial Action Objectives and remediation goals set forth in this Plan may be changed or revised, if necessary, as additional information becomes available. Sources of additional information include ground water modeling and ongoing monitoring. In lieu of individual constituent concentrations, the EPA may utilize the BAP Equivalent concentration of 7.8 mg/kg for the soil remediation goal. The final remediation goals will be selected and established in the ROD.

6.0 Summary of Remedial Alternatives

This section summarizes the most comprehensive remedial alternatives for both the soil and the ground water developed during the FS, plus the no-action alternative for each medium. These alternatives, along with other alternatives that are deemed less comprehensive, are analyzed in more detail in the FS, which is part of the administrative record file.

Soil Remedies:

- C **Alternative S-1 - No Further Action Alternative**
- C **Alternative S-2 - Excavation and on-site disposal**
- C **Alternative S-3 - Excavation, solidification/stabilization, on-site disposal, and capping**
- C **Alternative S-4 - Excavation, soil washing, and on-site disposal**
- C **Alternative S-5 - Excavation and bioremediation**
- C **Alternative S-6 - Excavation and off-site incineration**
- C **Alternative S-7 - In-situ solidification/stabilization**
- C **Alternative S-8 - The Preferred Soil Alternative - In-situ solidification/stabilization and run-off/run-on management**

Ground Water Remedies:

- C **Alternative GW-1 - No Action**
- C **Alternative GW-2 - UV-oxidation treatment, filtration, carbon adsorption and disposal of ground water**
- C **Alternative GW-3 - Biological treatment (fluidized GAC bed), clarification, filtration and disposal of ground water**
- C **Alternative GW-4 - Filtration, clay adsorption, carbon adsorption and disposal of ground water**
- C **Alternative GW-5 - Steam flushing**
- C **Alternative GW-6 - Co-solvent/alcohol flooding**
- C **Alternative GW-7 - In-situ Oxidation**

The FS describes a total of nine ground water alternatives and nine soil alternatives. This Proposed Plan details the seven most comprehensive soil alternatives, and six most comprehensive ground water alternatives, plus the no-action alternative for each medium. The alternatives presented in this Proposed Plan and their corresponding alternative numbers in the FS are as follows:

Proposed Plan of Action AT&SF Superfund Site

Alternative Title	Proposed Plan Number	Feasibility Study Number
Soil no action	S-1	S-1
Excavation and on-site disposal	S-2	S-2
Excavation, solidification/stabilization, on-site disposal, and capping	S-3	S-4
Excavation, soil washing, and on-site disposal	S-4	S-5
Excavation and bioremediation	S-5	S-6
Excavation and off-site incineration	S-6	S-7
In-situ solidification/stabilization	S-7	S-8
In-situ solidification/stabilization and run-off/run-on management	S-8	S-9
Ground water no action	GW-1	GW-1
UV-oxidation treatment, filtration, carbon adsorption and disposal of ground water	GW-2	GW-3
Biological treatment (fluidized GAC bed), clarification, filtration and disposal of ground water	GW-3	GW-5
Filtration, clay adsorption, carbon adsorption and disposal of ground water	GW-4	GW-6
Steam flushing	GW-5	GW-7
Co-solvent/alcohol flooding	GW-6	GW-8
In-situ Oxidation	GW-7	GW-9

The EPA will select the final remedial alternative based on the Site administrative record file and based on comments received during the public comment period.

6.1 Common Elements of Remedial Alternatives

Each of the remedial alternatives (other than Alternatives S-1 and GW-1; No Action) evaluated as part of the detailed analysis have certain assumptions and aspects in common. These are called the common elements. The common elements used in the FS are as follows:

- All costs were based on completion of the remedial action, or a maximum 30-year project lifetime.

Proposed Plan of Action **AT&SF Superfund Site**

- All costs have a degree of accuracy of +50% to -30% pursuant to the "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA - Interim Final" OSWER Directive 9355.3-01 (October 1988) insofar as it is consistent with the NCP.
- All costs and implementation times are estimates which should be used as a basis for a comparative analysis of the alternatives only, and not as a determination of absolute costs which will be expended during the project. These costs will be refined in the Remedial Design Work Plan.
- Net present value (also called present worth) costs are presented in this Proposed Plan so that the remedial action alternatives which may have costs incurred in different time periods can be compared on the basis of a single cost figure for each alternative. Also, although some alternatives may take over 30 years to achieve clean-up, a maximum cost period of 30 years is used for comparison purposes. Net present value cost, or present worth, is the amount of money that would have to be set aside at the inception of the response action in order to assure that funds will be available in the future to complete a given response action, assuming certain economic factors such as an interest rate and an inflation rate.
- Under the NCP, if a Remedial Action is selected that results in hazardous substances, pollutants, or contaminants remaining at the Site at concentrations that are above concentrations that allow for unlimited use and unrestricted exposure, the EPA must review the Remedial Action every five years. The five-year reviews are necessary at the Site because each remedial alternative evaluated allows hazardous substances to remain on-site in concentrations that restrict use. The EPA must conduct the reviews no less often than every five years after initiation of the Remedial Action in order to ensure that human health and the environment are being protected (See 42 U.S.C. Section 9621(c)). The EPA will conduct the statutory five-year reviews until ground water is restored to the MCLs.
- All ground water remediation alternatives (GW-series alternatives) shall meet ground water ARARs which are non-zero MCLGs, or MCLs where MCLGs are set at zero (see Sections 5.1 and 5.2). There are no chemical-specific ARARs for soils.
- All soil remediation (S-series) alternatives will address the estimated volume of contaminated soil (5,600 cubic yards).
- All ground water remediation (GW-series) alternatives will address the estimated volume of contaminated ground water (76,000,000 gallons).
- Institutional controls will be implemented during the response action to protect human health in the interim before the remedies have met the remediation goals. The EPA and the State may have limited independent ability to implement a restrictive covenant because the covenant must be put in place by the property owner, not by the EPA or the State. As part of the institutional controls for ground water, the New Mexico Office of the State Engineer (OSE) will issue an

Proposed Plan of Action AT&SF Superfund Site

order to restrict use of the portion of the aquifer contaminated by the Site until remediation goals have been met. The OSE order would have limited usefulness because the order is not enforceable by the EPA or the NMED. However, the EPA may require the potentially responsible party (PRP) to implement appropriate restrictive covenants through civil, judicial, or administrative enforcement under CERCLA. Despite any limitations associated with institutional controls, they will be implemented to the greatest extent possible to help minimize risk to human health and the environment during the implementation of the remedy.

- All alternatives include an operations and maintenance (O&M) component that involves annual ground water monitoring to assess the extent of contamination and the risks to human health.
- All selected ground water pump and treat alternatives are preceded by the following pretreatment steps:
 - **Oil/free product removal:** In the first step of light oil and DNAPL capture, a coalescing oil/water separator, an inclined plate separator or a gross knock-out/skimming tank will be used for free phase capture. The second step would be physical treatment to lower emulsified oils and product. Off-gases would be vented through either vapor phase carbon or a scrubbing system for volatile organic and odor capture. Separated DNAPL will be transferred to a heater tank to aid in further handling or treatment. The DNAPL separated in primary treatment steps and in the float would be handled by additional decanting, volume reduction (if technically and economically feasible), and offsite disposal or batch destruction by cavitation with treated water being added back into the main process flow for final polishing. Captured oil and DNAPL product will most likely be sent offsite for disposal.
 - **Equalization:** An equalization tank providing 1.5 to 2 hours of flow equalization would be used with air mixing to promote metals oxidation and suspended solids suspension. As all volatile compounds will have been removed in the first step, the equalization tank would be open top unless nuisance odors are anticipated. In this case, off-gas air would be captured and sent to the carbon adsorber or scrubber system used for the flotation unit.
 - **Neutralization/metals precipitation:** Metals will be precipitated by pH adjustment and oxidation. The use of metal coagulants to form sweep flocs may be considered to enhance minor heavy metal constituents. The pH adjustment toward neutrality can be done with CO_{2(g)} (re-carbonation) or by sulfuric acid addition. Solids from the clarification step will be de-watered for landfill disposal.
- Disposal of the treated ground water from a pump and treat alternative may be accomplished in two ways: on-site injection or off-site discharge to the Rio Grande River Basin. A combination of disposal alternatives may be required in order to allow the flexibility necessary for continuous

Proposed Plan of Action AT&SF Superfund Site

treatment. Treated ground water will meet all ARARs, either preliminary remediation goals (PRGs) or NPDES standards, prior to disposal.

- All alternatives will support the current and future anticipated land and ground water use at the Site.
- All of the soil alternatives have a phytoremediation component. The Site areas that are not in the proposed expansion track location, but that do contain low contaminant concentrations, will be phytoremediated. Plants proven to enhance degradation and removal of the contaminants will be placed in areas for residual management. These areas will be maintained as needed.

6.2 Alternatives S-1 and GW-1 - *No Further Action Alternative*

Alternatives S-1 and GW-1 are the baseline conditions against which other soil and ground water remedial alternatives are compared, as required by the NCP. Alternatives S-1 and GW-1 would provide no further remedial action at the Site. Alternatives S-1 and GW-1 would not address the human health risks identified in Section 4 of this document and, therefore, they do not protect human health. Alternatives S-1 and GW-1 do not reduce contaminant toxicity, mobility, or volume and they are not effective or permanent remedies. Because these no action alternatives leave hazardous substances on the Site, CERCLA requires the EPA to conduct a review of the Remedial Action every five years in order to assess risks to human health and the environment. Costs for conducting the five-year reviews are shown for Alternatives S-1 and GW-1. Alternatives S-1 and GW-1 are mentioned throughout the evaluation process for the purposes of comparison.

- Capital cost: \$0
- Annual operation and maintenance (O&M): \$0
- Net Present Value: \$186,000
- Implementation time: N/A

6.3 Alternative S-2 - *Excavation and on-site disposal*

Alternative S-2 includes the excavation of all soil above the PRGs in the AOC. The excavated soils will be placed in an on-site landfill. The soil will not be treated prior to deposition in the landfill. This alternative involves (1) excavating contaminated soils, (2) constructing a containment system consisting of a liner and a cap, (3) implementing institutional controls and (4) implementing dust suppression and erosion controls. All soils exceeding the PRGs will be placed in the landfill. The proposed landfill location is the wastewater reservoir. This alternative provides complete containment and immobilization of the waste material.

Prior to implementation of the excavation and capping activities, the following site preparation tasks will be performed:

Proposed Plan of Action **AT&SF Superfund Site**

- The monitoring wells in the excavation and cap area will be plugged and properly abandoned;
- The DNAPL recovery trenches in the WWR will be plugged and properly abandoned;
- The south and east portions of the site will be cleared and grubbed; and
- Run-off/run-on controls will be installed.

After the completion of the site preparation activities, the contaminated soil will be excavated and stockpiled. A composite liner system consisting of a 60-mil high-density polyethylene (HDPE) liner, and a protective/drainage layer will be constructed in the wastewater reservoir area. Additionally, a leachate collection system will also be installed with the liner system for the management of leachate in the lined area. The excavated soil will be placed in the lined area and a composite cover system will be constructed over the contaminated soil. The composite cover will consist of a 2-foot thick clay to clayey soil layer with a maximum hydraulic conductivity of 1×10^{-7} cm/s and a 6-inch thick topsoil layer. Erosion control measures will be utilized to ensure adequate drainage and minimize erosion across the site. All excavated areas will be backfilled with clean fill. The clay and topsoil materials will be transported to the site from an off-site source.

- Capital cost: \$2,230,000
Annual operation and maintenance (O&M): \$2,900
Present worth: \$2,740,000
Implementation time: 1 year

6.4 Alternative S-3 - *Excavation, solidification/stabilization, on-site disposal, and capping*

Alternative S-3 includes the excavation of highly contaminated soils in the AOC and treating them in a pug mill to reduce the mobility of the COCs. This alternative involves (1) the excavation of contaminated soils, (2) solidification/stabilization of the excavated soils, (3) consolidation of the treated soil in the WWR area, (4) construction of a cap over the treated soils and (5) implementation of institutional controls.

Prior to implementation, the site preparation activities described in Section 6.3 will be performed. After completion of the site preparation activities, the contaminated soils will be excavated for treatment. The excavated areas will be backfilled with clean fill material.

Contaminated soils will be excavated and moved to an on-site treatment facility. Solidification/stabilization will be implemented by mixing contaminated soils with pozzolanic materials, such as fly ash, cement kiln dust or concrete to physically immobilize the contaminants in the soil. The specific reagent will be determined during treatability studies. After treatment, the solidified soil will be placed in the WWR for containment with a clay cap. The cap will consist of a 2-foot thick clay to clayey soil layer with a maximum hydraulic conductivity of 1×10^{-7} cm/s and a 6-inch thick topsoil layer. Erosion control measures will be utilized to ensure adequate drainage and minimize erosion across the site. All excavated areas will be backfilled with clean fill. The clay

and topsoil materials will be transported to the site from an off-site source.

- Capital cost: \$3,120,000
Annual operation and maintenance (O&M): \$2,700
Present worth: \$3,450,000
Implementation time: 1 year

6.5 *Alternative S-4 - Excavation, soil washing, and on-site disposal*

Alternative S-4 includes the excavation of all high-risk soils in the AOC to prevent further mobility of the contaminants. Alternative S-4 involves (1) excavation of contaminated soils, (2) treatment via soil washing, (3) consolidation of treated soil in excavated areas, (4) consolidation of contaminated fines in the WWR, (5) construction of a cap to cover the contaminated fines and (6) implementation of institutional controls.

Prior to implementation, the site preparation activities described in Section 6.1 will be performed. After completion of the site preparation activities, the contaminated soils will be excavated for treatment. The excavated areas will be reconstructed with clean fill material and the treated coarse fraction of soil.

The excavated soil will be transported to an on-site soil washing facility, which consists of the following processes: (1) screening the soil for rocks and other debris, (2) washing the screened soil with high-pressure water and detergent, which separates the fine soil particles from the gravel and sand particles and (3) dewatering the fine soil particles. The coarse soil fraction will be spread into previously excavated areas and phytoremediated for residual low toxicity management.

The fine soil fraction will be disposed of in an on-site landfill located in the wastewater reservoir. The landfill liner and cover construction is the same as described in Alternative S-2. Erosion control measures will be utilized to ensure adequate drainage and minimize erosion across the site. All excavated areas will be backfilled with clean fill and the clay and topsoil materials will be transported to the site from an off-site source.

- Capital cost: \$4,750,000
Annual operation and maintenance (O&M): \$2,600
Present worth: \$5,270,000
Implementation time: 1 year

6.6 *Alternative S-5 - Excavation and bioremediation*

Alternative S-5 includes the excavation of all contaminated soils in the AOC and transporting them to on-site bioremediation repositories, otherwise known as landfarms. Alternative S-5 involves the (1) excavation of contaminated soils, (2) construction of bioremediation cells, (3) consolidation of

Proposed Plan of Action **AT&SF Superfund Site**

treated soil in the bioremediation cells, (4) aeration, nutrient and water addition to promote biological degradation, (5) consolidation of treated soil in previously excavated areas and the WWR and (6) implementation of institutional controls.

Prior to implementation, the site preparation activities described in Section 6.1 will be performed. After completion of the site preparation activities, the contaminated soils will be excavated for treatment. The excavated areas will be reconstructed with clean fill material and the bioremediated soil.

The soil will be segregated by COC: the soils containing elevated levels of metals will be placed in one treatment unit, the soils containing elevated levels organics will be placed in another treatment unit. The treatment site will be leveled prior to consolidation of the soil. Each treatment unit will be lined with 40-mil PVC and surrounded by up to a 3-foot tall earthen berm. Additionally, the liner will be covered with 12 inches of sand to prevent the aerating plow from damaging the PVC liner. A French drain, consisting of slotted PVC pipe and gravel, will be installed along the inner perimeter of the berm. The berm materials are constructed from clean soils on the site. Contaminated soil will be placed an average of 6 to 18 inches deep over the sand base. Nutrients will be added when the soil is placed in each treatment unit, either in solid form or as liquids combined with water. After all adjustments have been made to the soil, the treatment unit is covered with reinforced plastic to keep rainwater from saturating the soil or creating runoff-containing hazardous products. The cover also helps to maintain soil moisture and temperature. Occasionally, the soil will be aerated and additional nutrients will be added. Once the soil has been remediated below target levels, the soil will be removed from the treatment unit and spread out in the WWR area and in previously excavated areas.

- Capital cost: \$2,850,000
Annual operation and maintenance (O&M): \$2,900
Present worth: \$3,030,000
Implementation time: 1 year

6.7 *Alternative S-6 - Excavation and off-site incineration*

Alternative S-6 includes the excavation of all soil above risk-based target levels and transporting them to an off-site incinerator for disposal. This proposal involves the (1) excavation of contaminated soils, (2) transportation to a hazardous waste incinerator, (3) incineration of the contaminated soil, (4) consolidation of clean fill in the excavated areas, and aeration and (5) implementation of institutional controls.

Prior to implementation, the site preparation activities described in Section 6.1 will be performed. After completion of the site preparation activities, the contaminated soils will be excavated for treatment. The excavated areas will be reconstructed with clean fill material.

Contaminated soil will be excavated and loaded into containers for transportation to an incinerator. Each container will be lined with plastic, loaded with contaminated soil and covered with a tarp. The vehicle will be decontaminated, placarded, and manifested before it leaves the site. The location of the proposed incineration facility, operated by Safety-Kleen, is approximately 1,000 miles away from the site in Houston, Texas.

- Capital cost: \$8,110,000
Annual operation and maintenance (O&M): \$2,500
Present worth: \$8,640,000
Implementation time: 1 year

6.8 Alternative S-7 - *In-situ solidification/stabilization*

Alternative S-7 includes in-situ remedial treatment and closure of contaminated soils in the AOC that are above PRGs by utilizing solidification/stabilization processes. Alternative S-7 involves the (1) the excavation of contaminated soils, (2) consolidation of excavated soil in the WWR for treatment, (3) in-situ solidification/stabilization of the excavated soils and (4) implementation of institutional controls.

Prior to implementation, the site preparation activities described in Section 6.1 will be performed. After completion of the site preparation activities, the contaminated soils will be excavated for treatment. The excavated areas will be backfilled with clean fill material.

The wastewater treatment reservoir is the selected in-situ treatment area because the excavation to 5 feet bgs provides adequate volume for in-situ solidification/stabilization activities and will avoid additional excavation. High-risk soils from other areas of the site will be excavated and hauled to the wastewater reservoir area for remedial treatment. Macro-encapsulation will be implemented by mixing contaminated soils with pozzolanic materials, such as fly ash, cement kiln dust, or concrete. The specific reagent will be determined during treatability studies in the remedial design. Once all of the contaminated soil is placed in the treatment area, the soil will be stabilized in place. Reagent materials are mechanically mixed into the soil with augers. As the augers move down into the contaminated soil, the stabilizing agent is added as the augers mix the soil. Once the augers reach the lowest extent of contamination, they are removed and the soil is mixed a second time. After mixing of the soil and reagent is accomplished, the soil is left to cure. The stabilized material will have a compressive strength of at least 20 psi and a permeability of 1×10^{-6} cm/sec. All excavated areas will be backfilled with clean fill and institutional controls will be implemented.

- Capital cost: \$1,760,000
Annual operation and maintenance (O&M): \$2,700
Present worth: \$1,900,000
Implementation time: 1 year

6.9 *Alternative S-8 - The Preferred Soil Alternative - In-situ solidification/stabilization and run-on/run-off management*

Alternative S-8 includes in-situ remedial treatment and closure of contaminated soils in the AOC that are above PRGs by utilizing solidification/stabilization processes and covering the treated material with a 6-inch clay cap a HDPE liner, 6-inch soil cap which is topped with 12-inches of crushed rock for erosion and infiltration control. Alternative S-8 involves the (1) the excavation of contaminated soils, (2) consolidation of excavated soil in the WWR for treatment, (3) in-situ solidification/stabilization of the excavated soils, (4) placement of 6-inch clay cap, HDPE liner, 6" soil cap, and 12-inch erosion control cover over treated material and (5) implementation of institutional controls.

Prior to implementation, the site preparation activities described in Section 6.1 will be performed. After completion of the site preparation activities, the contaminated soils will be excavated for treatment. The excavated areas will be backfilled with clean fill material.

The wastewater treatment reservoir is the selected in-situ treatment area because the excavation to 5 feet bgs provides adequate volume for in-situ solidification/stabilization activities and will avoid additional excavation costs. High-risk soils from other areas of the site will be excavated and hauled to the wastewater reservoir area for remedial treatment. Macro-encapsulation will be implemented by mixing contaminated soils with pozzolanic materials, such as fly ash, cement kiln dust, or concrete. The specific reagent will be determined during treatability studies. Once all of the contaminated soil is placed in the treatment area, the soil will be stabilized in place. Reagent materials are mechanically mixed into the soil with augers. As the augers moved down into the contaminated soil, the stabilizing agent is added as the augers mix the soil. Once the augers reach the lowest extent of contamination, they are removed and the soil is mixed a second time. After mixing of the soil and reagent is accomplished, the soil is left to cure. The stabilized material will have a compressive strength of at least 20 psi and a permeability of 1×10^{-6} cm/sec. A 6" clay cap with a maximum hydraulic conductivity of 1×10^{-7} cm/s will be placed over the stabilized soils. A HDPE liner will be placed over this first 6" clay cap to ensure that surface water infiltration does not occur. A 6-inch soil cap will be placed over the HDPE liner and graded to a 2% slope to serve as an added barrier to infiltration. A 12-inch layer of crushed rock will be placed over the clay to serve as erosion control. All excavated areas will be backfilled with clean fill and institutional controls will be implemented.

- Capital cost: \$1,800,000
 Annual operation and maintenance (O&M): \$2,700
 Present worth: \$1,950,000
 Implementation time: 1 year

6.10 Alternative GW-2 - *UV-oxidation treatment, filtration, carbon adsorption and disposal of ground water*

Alternative GW-2 is a “pump and treat” ground water remedy where contaminated ground water is pumped out of the ground through extraction wells and brought to the surface where it is treated. Ground water would be pumped out of the shallow and intermediate aquifers through a series of extraction wells. This extracted water would flow through to an above-ground treatment plant located within the Site boundaries.

This alternative includes the ex-situ remedial treatment and disposal of ground water that is above the PRGs by utilizing ultra-violet (UV) oxidation treatment technology. Alternative GW-2 involves the (1) pumping of the contaminated ground water, (2) pretreatment as described in Section 6.1, (3) treatment by UV-oxidation, (4) filtration of precipitated solids, (5) treatment by granulated activated carbon and (5) disposal of treated water.

Prior to implementation, the pretreatment activities described in Section 6.1 will be performed. After completion of the site preparation activities, the contaminated ground water will be pumped for treatment.

Organics in the ground water will be oxidized through high intensity UV light combined with chemical oxidant addition (peroxide). The combination of UV light and peroxide addition greatly increases the oxidation rate, therefore reducing treatment time. Additionally, catalysts, which are photo-reactive and non-toxic, may be added to significantly enhance a systems’ performance. The specific combination of additives and catalysts will be determined in a treatability study.

After the UV-oxidation step, flow will be filtered to remove any oxidized precipitated solids. The final step consists of a granular activated carbon (GAC) polishing step to remove any recalcitrant organics.

- Capital cost: \$10,280,000
Annual operation and maintenance (O&M): \$1,710,000
Present worth: \$33,880,000
Implementation time: 2 years

6.11 *Alternative GW-3 - Biological treatment (fluidized GAC bed), clarification, filtration and disposal of ground water*

Alternative GW-3 is a “pump and treat” ground water remedy where contaminated ground water is pumped out of the ground through extraction wells and brought to the surface where it is treated. Ground water would be pumped out of the shallow and intermediate aquifers through a series of extraction wells. This extracted water would flow through to an above-ground treatment plant located within the Site boundaries.

This alternative includes the ex-situ remedial treatment and disposal of ground water that is above the PRGs by degrading organic constituents in a fixed film bioreactor. Alternative GW-3 involves the (1) pumping of the contaminated ground water, (2) pretreatment as described in Section 6.1, (3) biological treatment in a fixed film bioreactor, (4) filtration of precipitated solids, (5) treatment by granulated activated carbon and (5) disposal of treated water.

Prior to implementation, the pretreatment activities described in Section 6.1 will be performed. After completion of the site preparation activities, the contaminated ground water will be pumped for treatment.

Ex-situ biological treatment of the ground water will be conducted in bioreactors that will be open top units. In attached growth reactors, biomass is attached to a solid substrate, such as sand, rubber, plastic, activated carbon or resin, and forms a thick film. Contaminated water is passed through a bioreactor that houses the media and the biomass, which biodegrades the organic constituents in the water.

The primary factors influencing bioreactor design are the microbial organic utilization rates and the peak organic mass loading rate (i.e., flow rate times organic concentration). Treatability tests are necessary to determine these and other design parameters. Under most circumstances, bioreactors require a significant startup time to acclimate the microorganisms to the specific contaminants being treated before the bioreactor will operate at optimal degradation rates.

After the passing through the fixed film bioreactor, ground water will be filtered to remove any oxidized precipitated solids. The final step before disposal consists of a granular activated carbon polishing step to remove any recalcitrant organics.

- Capital cost: \$13,500,000
 Annual operation and maintenance (O&M): \$1,150,000
 Present worth: \$31,390,000
 Implementation time: 2 years

6.12 *Alternative GW-4 - Filtration, clay adsorption, carbon adsorption and disposal of ground water*

Alternative GW-4 is a “pump and treat” ground water remedy where contaminated ground water is pumped out of the ground through extraction wells and brought to the surface where it is treated. Ground water would be pumped out of the shallow and intermediate aquifers through a series of extraction wells. This extracted water would flow through to an above-ground treatment plant located within the Site boundaries.

Alternative GW-4 includes the ex-situ remedial treatment and disposal of ground water that is above the PRGs by utilizing removing the organic constituents in the ground water by clay adsorption. This alternative involves the (1) pumping of the contaminated ground water, (2) pretreatment as described in Section 6.1, (3) filtration of precipitated solids, (4) adsorption of organics onto clay, (5) treatment by granulated activated carbon, (5) disposal of organics adsorbed onto the clay media and (6) disposal of the treated ground water.

Prior to implementation, the pretreatment activities described in Section 6.1 will be performed. After completion of the site preparation activities, the contaminated ground water will be pumped for treatment.

The ground water will be pretreated and then treated in a clay adsorption unit first, then followed by a granulated activated carbon (GAC) unit. By treating the organics in the ground water with clay prior to GAC, the life of the GAC will be extended. However, depending upon the clay adsorption capacity and contaminant breakthrough profile, the GAC adsorbers may be loaded at a faster rate than with the other alternatives. The clay adsorbers’ ability to meet effluent requirements and applicable and appropriate or relevant treatment criteria while still providing an economical solution must be verified by treatability studies. The clay material will consist of a bentonite based sorbent, composed of 30% organically modified clay and 70% anthracite. The clays are manufactured to remove long chain and high molecular weight hydrocarbons, chlorinated hydrocarbons and some heavy metals. Additionally, the clay platelets, modified with a quaternary amine, have the ability to remove emulsified oil onto the clay surface. The clay can achieve oil absorption of up to 60% of its weight before exhaustion. Disposal of the clay as a hazardous waste will be accomplished by an off-site landfill or thermal destruction service.

After the passing through the GAC column, the ground water will be disposed of as previously mentioned in Section 6.1.

- Capital cost: \$10,130,000
 Annual operation and maintenance (O&M): \$2,080,000
 Present worth: \$38,200,000
 Implementation time: 2 years

6.13 *Alternative GW-5 - Steam Flushing*

This alternative is an enhanced extraction technique that injects steam into the subsurface to mobilize and/or vaporize DNAPL and its dissolved constituents. Ground water will be pumped after steam injection and treated with selected technologies from Alternatives GW-2 through GW-4.

This technology has been demonstrated to accelerate average DNAPL removal rates at a creosote contaminated utility pole yard in Visalia, CA. However, even with this technology, aqueous phase organics are still above site remediation standards as set forth in the site's ROD. Pump and treat operations would continue at this site after steam injection cessation to maintain hydraulic and contaminant containment as natural attenuation processes (including biological degradation) are monitored.

The conceptual arrangement considered for the site would be multiple steam injection wells, located in the Intermediate and Santa Fe Aquifers, arranged in a circle around areas that are suspected as concentrated contaminant source areas. Contaminant recovery would be through central extraction wells. Alternatively, to lower capital expense and to match the hydraulic treatment capability of the 300 gpm above ground treatment system, smaller cells may be treated, slowly working across the site, with injection and extraction wells arranged in an alternating pattern or in-line arrangement to prevent inappropriate contaminant migration. This technology may be utilized as a field scale study across part of the Site.

- Capital cost: \$27,080,000
 Annual operation and maintenance (O&M): \$2,480,000
 Present worth: \$61,030,000 with a 10 year project span
 Implementation time: 2 years

6.14 *Alternative GW-6 - Co-Solvent/Alcohol Flushing*

There is limited information on full-scale applications of co-solvent/alcohol flooding projects at creosote sites. Therefore, a small-scale field trial would be performed before full-scale implementation. An initial conceptual design of how co-solvent flushing might be implemented at the site was used to determine this technology's cost. A fundamental assumption of the ability to cycle alcohols and water flushes through the aquifer pore volumes in a reasonable period of time was assumed. Most creosote-based target demonstration treatment systems used surfactants, alkaline salts, and polymers rather than purely alcohol-based systems. A surfactant/co-solvent system could include low surfactant concentration systems, high surfactant concentration systems, surfactant/alcohol systems, high alcohol concentration systems, low alcohol concentration systems and alkaline-surfactant-polymer combination systems.

DNAPLs such as creosote have the ability to form pools, even above relatively weak capillary barriers such as medium and fine sand. Therefore, the threat of vertical pool mobilization from the

Proposed Plan of Action AT&SF Superfund Site

Intermediate Aquifer to the Deep Aquifer is real if co-solvent flooding lowers the interfacial tension, and downward mobilization occurs and the extraction techniques are insufficient to capture all of the DNAPL.

Delivery/recovery wells will be placed after analytical modeling of fluid flow patterns. The chemical delivery needs and time frame for floods will be based on the duration to flush a reasonable number of pore volumes. A phased modular approach is assumed. Linear sets of delivery and recovery wells across the contaminated zone will be used. This approach minimizes the delivery systems, pumps, piping and aboveground treatment systems by addressing a fraction of the target areas at any given time. Equipment requirements will be minimized by reusing the same equipment in each grid or module. The benefit of this approach is that smaller area floods may be more easily extracted and controlled to prevent vertical migration of DNAPLs that are mobilized through density or solubility changes.

The proposed system will concentrate primarily on alcohol flood technologies to avoid surfactant emulsion and foaming problems in aboveground treatment trains and to potentially allow reuse of the solvent. If an alcohol/surfactant combination is eventually selected, the induced gas flotation step to remove free product and oils will be reviewed for operational foaming problems and the need to select another separation device.

- Capital cost: \$21,560,000
Annual operation and maintenance (O&M): \$4,200,000
Present worth: \$62,720,000
Implementation time: 2 years

6.15 Alternative GW-7 - *In-Situ Oxidation*

In-situ chemical oxidation is based on the delivery of chemical oxidants to contaminated media in order to destroy the contaminants by converting them to simple compounds commonly found in nature. The oxidants applied in this process are typically hydrogen peroxide (H_2O_2), potassium permanganate ($KMnO_4$), ozone, and to a lesser extent, dissolved oxygen (DO). The most common field applications have been based on Fenton's Reagent where hydrogen peroxide is applied with an iron catalyst creating a hydroxyl free radical. This hydroxyl free radical is capable of oxidizing complex organic compounds. Residual hydrogen peroxide decomposes into water and oxygen in the subsurface and any remaining iron precipitates out. This process has been applied in waste treatment fields and ground water and soil remediation.

The volume and chemical composition of individual treatments are based on the contaminant levels and volume, subsurface characteristics and pre-application laboratory test results. The methods for delivery of the chemical may vary. The oxidant can be injected through a well or injector head directly into the subsurface, mixed with a catalyst and injected or combined with extracted water from the site and then injected and recirculated. In the case of hydrogen peroxide, stabilizers may

be needed because of the compound's reactivity.

The following are potential concerns when using in-situ chemical oxidants:

- Constituents in the injected fluid exceed a primary or secondary drinking water standard;
- Formation of toxic intermediate products;
- Unknown toxicity of a constituent of the oxidant/catalyst;
- Adequate delivery of the chemical oxidants to the contaminated area;
- Formation/mobilization of colloids due to breakdown of natural organic material or other reduced constituents; and
- Migration of contaminants away from the plume or source area.

Due to health, safety and economic issues, the oxidants that were considered for use at the Former Tie Treating Facility were hydrogen peroxide, potassium permanganate and ozone.

- Capital cost: \$12,630,000
Annual operation and maintenance (O&M): \$1,320,000
Present worth: \$32,140,000
Implementation time: 2 years

Proposed Plan of Action
AT&SF Superfund Site

Alternative Cost Estimate Table				
Alternative Title	Proposed Plan Number	Capital Cost	Annual O&M Cost	Net Present Value
Soil - No Action	S-1	\$0	\$0	\$100,000
Excavation and on-site disposal	S-2	\$2,230,000	\$2,900	\$2,740,000
Excavation, solidification/stabilization, on-site disposal, and capping	S-3	\$3,120,000	\$2,700	\$3,450,000
Excavation, soil washing, and on-site disposal	S-4	\$4,750,000	\$2,600	\$5,270,000
Excavation and bioremediation	S-5	\$2,850,000	\$2,900	\$3,030,000
Excavation and off-site incineration	S-6	\$8,110,000	\$2,500	\$8,640,000
In-situ solidification/stabilization and capping	S-7	\$1,760,000	\$2,700	\$1,900,000
The Preferred Soil Alternative In-situ solidification/stabilization and run-off/run-on management	S-8	\$1,800,000	\$2,700	\$1,950,000
Ground water - No Action	GW-1	\$0	\$0	\$1,860,000
UV-oxidation treatment, filtration, carbon adsorption and disposal of ground water	GW-2	\$10,280,000	\$1,710,000	\$33,880,000
Biological treatment (fluidized GAC bed), clarification, filtration and disposal of ground water	GW-3	\$13,500,000	\$1,150,000	\$31,380,000
Filtration, clay adsorption, carbon adsorption and disposal of ground water	GW-4	\$10,130,000	\$2,080,000	\$38,200,000
Steam Flushing	GW-5	\$27,080,000	\$2,480,000	\$61,030,000
Co-Solvent/Alcohol Flushing	GW-6	\$21,560,000	\$4,200,000	\$62,720,000
In-Situ Oxidation	GW-7	\$12,630,000	\$1,320,000	\$32,140,000

7.0 Comparative Analysis of Alternatives

The comparison of alternatives is developed for each of the following nine NCP criteria:

- C Overall protection of human health and the environment;
- C Compliance with ARARs;
- C Long-term effectiveness and permanence;
- C Reduction in toxicity, mobility, and volume through treatment;
- C Short-term effectiveness;
- C Implementability;
- C Cost;
- C State acceptance;
- C Community acceptance.

These criteria are defined in Section 4 of the Feasibility Study. The first seven criteria are discussed in this Section of the Proposed Plan. The final two criteria, State acceptance, and Community acceptance, are discussed in Section 8 of this Proposed Plan.

The comparative analysis describes the strengths and weaknesses of the alternatives relative to one another with respect to each NCP criterion. The alternative(s) that performs the best overall in that category is discussed first, with the other alternatives discussed in order according to their relative success at satisfying the NCP criterion.

The alternatives intended to address the unsaturated zone soil (S-series) and ground water (GW-series) were kept separate throughout the FS evaluation, and that approach is continued in this section of the Proposed Plan.

7.1 Comparative Analysis of Soil Alternatives

Alternative S-1, No Action, does not actively address the contaminated soil. Alternatives S-2 through S-6 utilize excavation and either on-site disposal, solidification/stabilization, capping, soil washing, bioremediation or off-site incineration. Alternatives S-7 and S-8 utilize in-situ solidification/stabilization and capping or run-on/run-off management.

7.1.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment is based on a combination of criteria, compliance with ARARs, short-term effectiveness, long-term effectiveness, and reduction in toxicity, mobility, and volume. The Site Risk Assessments concluded that the contaminated soils currently pose a risk to human health and the environment. In addition, the concentration of contaminants in the soil could continue to contaminate the ground water above the MCLs. All the soil alternatives, with the exception of S-1, are protective of human health and the environment as

Proposed Plan of Action

AT&SF Superfund Site

far as direct exposure to soil is concerned; however, soil contamination poses a threat to humans in that it could impact ground water which is subsequently used by humans.

Alternative S-1 offers no additional protectiveness, and is not protective of either human health or the environment.

7.1.2 Compliance with Applicable or Relevant and Appropriate Requirements

A detailed discussion of ARARs is provided in the Feasibility Study Report and is referenced in the following discussion. Where no ARARs exist or where ARARs may not be sufficiently protective, the NCP prescribes methods for selection of remediation goals. Since there are no chemical-specific ARARs for soils, remediation goals for the Site soil were selected based on guidance documents outlining scientific methods to determine protective goals. The remediation goals for the Site soils are set at a level such that, if the remediation goals are met, ground water cannot become impacted above the MCLs for these compounds through contaminant migration from soils. In addition, if the remediation goals are met, ecological receptors will not be adversely impacted by on-site contamination.

One potential issue of concern for the soil remediation is the RCRA Land Disposal Restrictions (LDRs). However, since the contaminated soils will be consolidated and treated within the Site AOC, LDRs will not be invoked. This is consistent with the NCP. See NCP Preamble, 55 Federal Register 8758 - 8760, March 8, 1990.

Because there are no chemical-specific ARARs for soil, and because all the soil alternatives would meet location-specific and action-specific ARARs, all of the soil alternatives, with the exception of S-1, would comply with ARARs.

Alternative S-6 will comply with site-specific ARARs. The incineration process will be performed by a facility that is in compliance with all federal and state ARARs concerning hazardous waste treatment facilities and air emissions. Additionally, all excavation activities will comply with local, state and federal air quality requirements.

Alternative S-8 will comply with site-specific ARARs. The solidification/stabilization process will be designed and operated to comply with all federal and state ARARs concerning hazardous waste treatment facilities and air emissions. It will also comply with RCRA removal and treatment requirements and land disposal restrictions. This alternative will not trigger the land ban on creosote-contaminated soil because it is part of the Site AOC and is being treated and disposed of in place. The disposal cell construction and management will be conducted in compliance with all federal and state ARARs concerning storm water discharge. Additionally, all construction activities will comply with local, state and federal air quality regulations.

Alternative S-7 will comply with site-specific ARARs. The solidification/stabilization process will

Proposed Plan of Action AT&SF Superfund Site

be designed and operated to comply with all federal and state ARARs concerning hazardous waste treatment facilities and air emissions. It will also comply with RCRA removal and treatment requirements and land disposal restrictions. This alternative will not trigger the land disposal restrictions on creosote contaminated soil because it is part of the Site AOC and is being treated and disposed of in-place. Additionally, all construction activities will comply with local, state and federal air quality requirements.

Alternative S-4 will comply with site-specific ARARs. The soil washing process will be designed and operated to comply with all federal and state ARARs concerning hazardous waste treatment facilities and air emissions. It will also comply with RCRA removal and treatment requirements and land disposal restrictions. This alternative may be considered as a RCRA corrective action management unit (CAMU) in accordance with EPA guidelines. Additionally, all construction activities will comply with all local, state and federal air quality requirements.

Alternative S-3 will comply with site-specific ARARs. The solidification/stabilization process will be designed and operated to comply with all federal and state ARARs concerning hazardous waste treatment facilities and air emissions. It will also comply with RCRA removal and treatment requirements and land disposal restrictions. This alternative will not trigger the land disposal restrictions on creosote-contaminated soil because it is part of the Site AOC and is being disposed of in-place. Additionally, construction activities will comply with local, state and federal air quality requirements.

Alternative S-2 will comply with site-specific ARARs. The landfill will be designed, constructed, and managed to comply with all federal and state ARARs concerning RCRA Subtitle C hazardous waste landfills. The landfill construction and management will be conducted in compliance with all federal and state ARARs concerning storm water discharge. This alternative will not trigger the land disposal restrictions on creosote contaminated soil because it is part of the Site Area of Concern (AOC) and is being disposed of in-place. Additionally, construction activities will comply with local, state and federal air quality requirements.

Alternative S-5 will comply with site-specific ARARs. The bioremediation process will be designed and operated to comply with all federal and state ARARs concerning hazardous waste treatment facilities and air emissions. Additionally, all construction activities will comply with local, state and federal air quality requirements.

Alternative S-1 will not comply with site-specific ARARs.

7.1.3 Long-term Effectiveness and Permanence

Alternative S-6 would have the highest long term effectiveness and permanence. This alternative affords long-term protection of potential receptors by destroying the contaminants in the soil through incineration. The contaminants will be volatilized or combusted in a hazardous waste incinerator.

Proposed Plan of Action

AT&SF Superfund Site

The excavated areas on-site will be backfilled with clean fill material.

Alternative S-8 has high long term effectiveness and permanence. If properly implemented, in-situ treatment by solidification/stabilization will effectively immobilize soil contaminants. The stabilized soils will be treated in-situ in the WWR and then capped in place. The layer of crushed rock will function as a barrier between the stabilized soils and nearby residents and site workers. The crushed rock also serves to prevent storm water runoff from the site and to minimize the transport of contaminants by surface water run-off, infiltration or airborne dust.

Alternatives S-3 and S-7 have high long term effectiveness and permanence if properly implemented. The treatment by solidification/stabilization will effectively immobilize soil contaminants. The stabilized soils will be placed in the WWR and capped in place. The cap will function as a barrier between the stabilized soils and nearby residents and site workers. The cap also serves to prevent storm water runoff from the site and to minimize the transport of contaminants by surface water run-off, infiltration or airborne dust.

Alternative S-5 affords long-term protection of potential receptors by removing the contaminants from the soil through bioremediation. If properly implemented, treatment by bioremediation will degrade the contaminants in the soil and reduce the toxicity of the COCs.

Alternative S-2 and S-4 have fairly high long term effectiveness and permanence. The landfill will function as a barrier between the contaminated soils and nearby residents and site workers. The landfill also minimizes the transport of contaminants by surface-water runoff or infiltration. Furthermore, the source materials will be contained and therefore, further contamination of the ground water will be prevented.

Alternative S-1 does not include treatment so contaminated soil would have poor long-term effectiveness and permanence.

7.1.4 Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative S-6 completely reduces the mobility of the contaminants in the soil in all of the excavated soils. Incineration also reduces the volume and the toxicity via the combustion process. Incineration volatilizes or combusts the constituent, which reduces the toxicity and also reduces the soil to ash, which reduces the volume of the waste.

Alternative S-8 will significantly reduce the mobility of the contaminants by chemically binding and encapsulating them with the solidification/stabilization process. The clay cap serves as an infiltration barrier that will prevent leaching of contaminants to the ground water. The crushed rock layer also enhances the mobility reduction of this alternative. This treatment process, however, does not reduce the volume or the toxicity of the contaminants. Implementation of this remedy may increase the volume of contaminated soil by 10 to 30% through the solidification/stabilization

process.

Alternative S-7 will significantly reduce the mobility of the contaminants by chemically binding and encapsulating them with the solidification/stabilization process. This treatment process, however, does not reduce the volume or the toxicity of the contaminants. Implementation of this remedy may increase the volume of contaminated soil by 10 to 30% through the solidification/stabilization process.

Alternative S-3 will significantly reduce the mobility of the contaminants by chemically binding and encapsulating them with the solidification/stabilization process. Capping also enhances the mobility reduction of this alternative. This treatment process, however, does not reduce the volume or the toxicity of the contaminants. Implementation of this remedy may increase the volume of contaminated soil by 10 to 30% through the solidification/stabilization process.

Alternative S-5 does not reduce the mobility or the volume of contaminated soil except to the extent that more mobile compounds are effectively biodegraded. Bioremediation does reduce the toxicity of the contaminants in the soil by degrading organic compounds into water and carbon dioxide.

Alternative S-4 does not reduce the toxicity or the mobility of the contaminants in the soil; however, soil washing does reduce the volume of the contaminated soil. Capping reduces the mobility of the contaminants in the soil. By combining soil washing and capping treatment technologies, this alternative provides reduction of mobility and volume of the contaminants in the soil.

Alternative S-2 does not prescribe any treatment of the contaminated soils at the site; therefore, the toxicity and volume of contaminated soils will not be reduced. The mobility of the contaminants will be reduced by the prevention of contaminated surface water run-off and prevention of contaminated airborne dust. The liner will prevent leaching of any contaminants to the ground water.

Alternative S-1 does not include treatment so contaminated soil would have no reduction of toxicity, mobility, or volume.

7.1.5 Short-term Effectiveness

A comparison of the alternatives with respect to the short-term effectiveness shows that all alternatives, with the exception of S-1, can be made to be protective of the community and workers.

Excavation, solidification/stabilization, disposal, and cap construction are full-scale technologies that will address site contaminants in a relatively short period of time. During remedial activities, short-term risks will be posed to site workers involved in handling and processing the contaminated soil. Risks may include dermal contact and inhalation. Nearby residents may also be at risk due to inhalation of fugitive emissions. Appropriate measures such as use of personal protective equipment will be used to protect workers. Fence line monitoring will guide implementation of monitoring to

control fugitive emissions to eliminate risk to residents.

7.1.6 Implementability

All of the alternatives are implementable with regard to technical feasibility, administrative feasibility, and availability of resources.

Alternative S-7 and S-8 are full-scale technologies which have been successfully used at other Superfund sites in treating similar contaminants in soil. Before conducting the remedial action, a treatability study will need to be performed to evaluate the effectiveness of in-situ solidification/stabilization technology for the site constituents. Implementation of this alternative is relatively straight forward, as it requires a relatively simple treatment process and simple construction and earthmoving techniques. Operation of the solidification/stabilization process equipment will require engineering measures to control air emissions, fugitive dust, runoff, erosion and sedimentation.

Alternative S-6 is a full-scale technology which as been successfully used at other Superfund Sites for disposing of contaminated soil. Implementation of this alternative is relatively easy, as it requires relatively simple and earthmoving techniques and an existing permitted hazardous waste incinerator. Implementation time is also relatively short. Excavation of the contaminated soil will require engineering measures to control air emissions, fugitive dust, runoff, erosion and sedimentation.

Alternative S-3 is a full-scale technology which has been successfully used at other Superfund sites in treating similar contaminants in soil. Before conducting the remedial action, a treatability study will need to be performed to evaluate the effectiveness of ex-situ solidification/stabilization technology for the site constituents. Implementation of this alternative is relatively straightforward. It requires a relatively simple treatment process and simple construction and earthmoving techniques. Operation of the solidification/stabilization process equipment will require engineering measures to control air emissions, fugitive dust, runoff, erosion and sedimentation.

Alternative S-5 is a full-scale technology which as been successfully used at other Superfund sites in treating similar contaminants in soil. Before conducting the remedial action, a treatability study will need to be performed to evaluate the required the nutrient load, the aeration rate and the degradation rate of the microbes. Implementation of this alternative is relatively easy, as it requires a relatively simple treatment process and simple construction and earthmoving techniques. The treatment time for this technology however is lengthy. The bioremediation cells will require engineering measures to control air emissions, fugitive dust, runoff, erosion and sedimentation.

Alternative S-4 is a full-scale technology which as been successfully used at other Superfund sites in treating similar contaminants in soil. Before conducting the remedial action, a treatability study will need to be performed to evaluate the combination of detergents and surfactants used to remove contaminants and fine soil particles from the contaminated soils. Implementation of this alternative

Proposed Plan of Action

AT&SF Superfund Site

is relatively easy, as it requires a relatively simple treatment process and simple construction and earthmoving techniques. Operation of the soil washing process equipment will require engineering measures to control air emissions, fugitive dust, runoff, erosion and sedimentation.

Alternative S-2 is a full-scale technology which has been successfully used at other Superfund sites. Vendors offering construction equipment and materials in the vicinity of the site are available. Local infrastructure will be able to support the use of this technology. This treatment process will require engineering measures to control air emissions, fugitive dust, runoff, erosion and sedimentation. Standard procedures can monitor the effectiveness of this technology. Authorizations to implement this technology include standard regulatory compliance requirements.

7.1.7 Cost

Capital Costs

S-1 has a capital cost of \$0.
S-2 has a capital cost of \$2,230,000.
S-3 has a capital cost of \$3,120,000.
S-4 has a capital cost of \$4,750,000.
S-5 has a capital cost of \$2,850,000.
S-6 has a capital cost of \$8,110,000.
S-7 has a capital cost of \$1,760,000.
S-8 has a capital cost of \$1,710,000.

Operation and Maintenance Costs

S-1 has an annual O&M cost of \$0.
S-2 has an annual O&M cost of \$2,900.
S-3 has an annual O&M cost of \$2,700.
S-4 has an annual O&M cost of \$2,600.
S-5 has an annual O&M cost of \$2,900.
S-6 has an annual O&M cost of \$2,500.
S-7 has an annual O&M cost of \$2,700.
S-8 has an annual O&M cost of \$2,700.

Net Present Value

S-1 has a net present value cost of \$100,000.
S-2 has a net present value cost of \$2,740,000.
S-3 has a net present value cost of \$3,450,000.
S-4 has a net present value cost of \$5,270,000.
S-5 has a net present value cost of \$3,030,000.
S-6 has a net present value cost of \$8,640,000.
S-7 has a net present value cost of \$1,900,000.
S-8 has a net present value cost of \$1,950,000.

7.1.8 Overall

Overall, Alternative S-8, provides the best balance of tradeoffs among the other alternatives with respect to the seven criteria evaluated. Alternative S-8 is the EPA's Preferred Alternative because of its high level of protection of human health and the environment, and because its high level of overall reductions in the mass, volume, and toxicity of contaminants, compared to its cost.

7.2 Comparative Analysis of Ground Water Alternatives

Alternative GW-1, No Action, does not actively address the contaminated ground water. Alternatives GW-2, GW-3, and GW-4 utilize ground water pump and treat technology. Alternative GW-5 utilizes thermal treatment via steam flushing. Alternative GW-6 utilizes co-solvent/alcohol flushing. Alternative GW-7 utilizes in-situ Oxidation to treat the ground water.

7.2.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment is based on a combination of criteria, compliance with ARARs, short-term effectiveness, long-term effectiveness, and reduction in toxicity, mobility, and volume. The Site Risk Assessments concluded that the contaminated ground water currently poses a risk to human health. All of the ground water alternatives, with the exception of GW-1, are protective of human health and the environment.

Since Alternative GW-1 is not protective of human health or the environment, it is not eligible for selection under the NCP (see 40 CFR §300.430(f)(1)(i)(A)).

7.2.2 Compliance with Applicable or Relevant and Appropriate Requirements

All GW-series alternatives except Alternative GW-1 would comply with chemical-specific ARARs because ground water would be treated until it is below the MCLs or the MCLGs. Alternative GW-1 will not meet chemical-specific ARARs because no remedial actions are conducted at the Site under this alternative.

For each of the Alternatives, an ARAR waiver over portions of the site where non-recoverable DNAPLs are present might be necessary. Treatment residual solids may require compliance with RCRA or hazardous materials transportation regulations for off-site disposal.

7.2.3 Long-term Effectiveness and Permanence

Alternative G-1 would not be effective in the long-term because remediation goals would not be met and residual risk would remain for an indefinite period of time.

All of the alternatives that involve treatment provide the same high degree of long-term effectiveness in that only acceptable residual risk will remain once the remediation goals have been met, so no additional engineering or administrative controls will be necessary. However, because the complete removal of DNAPLs from the subsurface is often not practicable, long term monitoring will be required to verify hydraulic control and treatment system efficiency such that migration of contaminants does not occur.

7.2.4 Reduction of Toxicity, Mobility, and Volume through Treatment

All ground water treatment alternatives, except for Alternative GW-1, use treatment to reduce toxicity, mobility, and volume of contaminants. Some treatment residuals (precipitated sludges, biosolids and spent clay or GAC) are inherent in each process. Any ex-situ treatment (Alternatives GW-2, GW-3, and GW-4), or enhanced extraction process (Alternatives GW-5, GW-6, and GW-7) must combine with aggressive pumping to achieve reduction in mobility, toxicity and volume of contaminants in the ground water. There is the potential in Alternatives GW-5, GW-6, and GW-7, that the DNAPL contamination might migrate deeper into the Santa Fe Aquifer if an adequate capture system is not in place. Alternative GW-7 (in-situ oxidation) poses a risk of mobilizing some metals from the aquifer matrix.

7.2.5 Short-term Effectiveness

Alternatives GW-2 through GW-7 also have risks in the short term. Pumping, treating, and disposing of contaminated ground water may adversely expose workers during handling and processing activities. Workers could also be exposed to fugitive emissions from the process equipment. However, air monitoring and the use of PPE will be implemented as necessary to reduce health risks. Exposure risks to nearby residents should be controllable and therefore minimized. Traffic associated with the remedial activities could increase wear of local roads and increase the potential for accidents. This latter risk is somewhat reduced because transport activities will require safety-trained individuals.

Alternative GW-1 may be implemented immediately; the remaining alternatives will require some laboratory and/or field treatability pilot testing to verify performance assumptions. Alternatives GW-2 through GW-4 should be designed so that they can be implemented over a 2-year time span from remedy selection through design, construction and commissioning and startup activities.

Alternatives GW-5, GW-6, and GW-7 are based on the premise of either mobilizing contaminants for extraction or in-situ destruction. As a result, short term increases in concentrations of mobilized contaminants or reaction by-products will be evident. Extraction, surface treatment, and re-injection of ground water will allow plume reduction, eventually leading to aquifer restoration.

Alternative GW-1 is not effective in the short term because this alternative represents a no-treatment scenario and the contamination would remain above remediation goals indefinitely.

7.2.6 Implementability

Ground water “pump and treat” is well proven and capable of containing the contaminant plume. The treatment alternatives should be readily available and are generally proven. However, treatability studies will be required for Alternatives GW-2 through GW-7 to refine applicable design

Proposed Plan of Action

AT&SF Superfund Site

criteria and verify performance on the potentially variable site-specific water quality matrix of contaminants and water characteristics.

The use of a fluidized bed reactor (FBR) with carbon media (Alternative GW-4) could allow a phased approach in terms of equipment addition, if required. Polishing-step GAC adsorbers are assumed unnecessary to reach ARAR goals for semi-volatile compounds and are not anticipated in the selected remedy. This treated water, will be re-injected at the edge of the plume to create a mounding effect. This mounding effect will hinder further migration of existing contamination. Depending upon the FBR treatability study results, the need and cost for carbon adsorption or oxidant (hydrogen peroxide) addition will be evaluated. These minor adjustments could include one or more of the following:

- Adjusting the rate of extraction from some or all wells.
- Discontinuing pumping at individual wells where cleanup levels have been attained.
- Pulsed pumping of some or all extraction wells to eliminate flow stagnation areas, allow time for sorbed contaminants to partition into ground water, or otherwise facilitate recovery of contaminants from the aquifer.
- Installing additional ground water extraction wells to facilitate or accelerate cleanup of the contaminant plume.
- Treating “hot spots” by in-situ oxidation.

It might be possible to allow natural attenuation to be implemented after the several years of pump and treat activities. A trend of declining contaminant levels confirmed over several successive rounds of sampling in the first several years would indicate that source control measures combined with remedial pumping and ex-situ treatment have been effective. Modeling could then be used to determine if natural attenuation will achieve remediation objectives in a reasonable time frame. Institutional controls would be implemented to prevent the use of the contaminated water until cleanup levels have been attained. The institutional control would consist of an ordinance prohibiting the drilling of wells within the vicinity of the site and previous off-site plume locations.

7.2.7 Cost

Capital Costs

GW-1 has a capital cost of \$0.

GW-2 has a capital cost of \$10,280,000.

GW-3 has a capital cost of \$13,500,000.

GW-4 has a capital cost of \$10,130,000.

GW-5 has a capital cost of \$27,080,000.

GW-6 has a capital cost of \$21,560,000.

GW-7 has a capital cost of \$12,630,000.

Operation and Maintenance Costs

GW-1 has an annual O&M cost of \$0.
GW-2 has an annual O&M cost of \$1,710,000.
GW-3 has an annual O&M cost of \$1,150,000.
GW-4 has an annual O&M cost of \$2,080,000.
GW-5 has an annual O&M cost of \$2,480,000.
GW-6 has an annual O&M cost of \$4,200,000.
GW-7 has an annual O&M cost of \$1,320,000.

Net Present Value

GW-1 has a net present value cost of \$186,000.
GW-2 has a net present value cost of \$33,880,000.
GW-3 has a net present value cost of \$31,380,000.
GW-4 has a net present value cost of \$38,200,000.
GW-5 has a net present value cost of \$61,030,000.
GW-6 has a net present value cost of \$62,720,000.
GW-7 has a net present value cost of \$32,140,000.

7.2.8 Overall

The conclusions of the detailed comparative analysis of the ground water remedial alternatives are discussed below.

Due to: 1) the complex nature of the geology at the Site, 2) the fact that creosote DNAPL is one of the principal threat wastes, and 3) the only source of drinking water for the City of Albuquerque is being impacted by Site constituents, as its preferred alternative ground water remedial action, the EPA is proposing an aggressive performance-based approach for remediation of the Site ground water. This performance-based approach consists of the following components:

- Ground water restoration through pump and treat; and
- DNAPL source removal and hot spot treatment;

Alternatives GW-2, GW-3, and GW-4 are ground water pump and treat remedies that will be effective in remediating contaminated ground water to the PRG levels that are presented in Section 5.2 of this proposed plan. Each of these three alternatives provides a good balance of tradeoffs with respect to the seven criteria evaluated in this Section. These three alternatives offers a high degree of protection of human health and the environment mainly because they reduce the mass and volume of contaminants through treatment in the Shallow and Intermediate aquifer zones, and ground water restoration will occur. These alternatives achieve this high degree of protectiveness and permanence for a present value cost ranging from \$31.4 to \$38.2 million. Each of these alternatives is

Proposed Plan of Action **AT&SF Superfund Site**

implementable. As a result, the EPA has decided to select a performance-based approach as its preferred alternative for ground water restoration at the Site. Either GW-2, GW-3, or GW-4, or a combination thereof, may be utilized to treat the ground water, once it has been extracted from the subsurface. However, the ground water PRGs that are presented in Section 5.2 of this proposed plan **must** be met in both the aquifer, as well as in the treated ground water.

In order to meet the performance-based PRGs for ground water, some type of DNAPL source removal and hot spot treatment will be necessary. Alternatives GW-5, GW-6, and GW-7 are technologies that are effective in removing DNAPL and treating hot spot areas. Each of these three alternatives provides a balance of tradeoffs with respect to the seven criteria evaluated in this Section. These three alternatives provide varying degrees of protection of human health and the environment mainly because of their potential to mobilize the DNAPL contamination and cause it to migrate deeper into the Santa Fe Formation aquifer if an adequate capture system is not in place. However, these three alternatives are capable of removing large quantities of DNAPL. As such, the EPA has decided to select a performance-based approach as its preferred alternative for DNAPL removal and hot spot treatment at the Site. Either GW-5, GW-6, or GW-7, or a combination thereof, may be utilized for DNAPL removal and hot spot treatment. The performance criteria will be DNAPL mass reduction so that the ground water PRGs that are presented in Section 5.2 of this proposed plan will be met. The cost for this performance-based approach will vary depending upon the alternatives chosen and the amount of DNAPL that must be removed.

Alternative GW-1 does not protect human health or the environment and, therefore, cannot be selected as a remedy under the NCP (40 CFR §300.430 (f)(1)(i)(A)).

8.0 The Preferred Alternative

Potential Innovative Technologies

The EPA is committed to reviewing the potential use of innovative technologies at this Site. However, because of the unique geological characteristics, i.e., several thousand vertical feet of sands and gravel, the inherent nature of the DNAPL to sink (until an aquitard is encountered, or the DNAPL mass becomes residual in the aquifer matrix and can no longer migrate downward via gravity) and the fact that the Site is located over the only drinking water aquifer for the Albuquerque Region, the potential risks may outweigh the potential benefits of the available innovative technologies that were reviewed. As new technologies are developed, or as existing innovative technologies are refined, these alternatives will be reviewed to determine if they can successfully remediate the DNAPL creosote in the future.

At a minimum, innovative technologies will be reviewed during each five-year review for their applicability to this Site.

Preferred Soil Alternative

Alternative S-8, in-situ solidification/stabilization and run-off/run-on management is the preferred soil remediation alternative. Alternative S-8 is recommended because it provides the best balance of tradeoffs among the other alternatives with respect to the seven criteria evaluated, and because it will achieve substantial risk reduction by treating the entire volume of the source soil materials constituting a low-level, but significant threat at the Site. Alternative S-8 is the preferred alternative because of its high level of protection of human health and the environment, because of its permanence, because of its attainment of ARARs, and because of its high level of overall reductions in the mobility of contaminants through treatment, compared to its relatively low cost.

Preferred Alternative for Ground Water

As its preferred alternative for remedial action, the EPA is proposing an aggressive performance-based approach for remediation of the Site ground water. This performance-based approach consists of the following components:

- Ground water restoration through pump and treat; and
- DNAPL source removal and hot spot treatment;

Alternatives GW-2, GW-3, and GW-4 are long term ground water pump and treat remedies that will be effective in remediating contaminated ground water to the PRG levels that are presented in Section 5.2 of this proposed plan. Each of these three alternatives provides a good balance of tradeoffs with respect to the seven criteria evaluated in this Section. These three alternatives offers a high degree of protection of human health and the environment mainly because they reduce the

Proposed Plan of Action **AT&SF Superfund Site**

mass and volume of contaminants through treatment in the Shallow and Intermediate aquifer zones, and ground water restoration will occur. These alternatives achieve this high degree of protectiveness and permanence for a present value cost ranging from \$31.4 to \$38.2 million. Each of these alternatives is implementable. As a result, the EPA has decided to select a performance-based approach as its preferred alternative for ground water restoration at the Site. Either GW-2, GW-3, or GW-4, or a combination thereof, may be utilized to treat the ground water, once it has been extracted from the subsurface. However, the ground water PRGs that are presented in Section 5.2 of this proposed plan **must** be met in both the aquifer, as well as in the treated ground water.

In order to meet the performance-based PRGs for ground water, some type of DNAPL source removal and hot spot treatment will be necessary. Alternatives GW-5, GW-6, and GW-7 are technologies that are effective in removing DNAPL and treating hot spot areas. Each of these three alternatives provides a balance of tradeoffs with respect to the seven criteria evaluated in this Section. These three alternatives provide varying degrees of protection of human health and the environment mainly because of their potential to mobilize the DNAPL contamination and cause it to migrate deeper into the Santa Fe Formation aquifer if an adequate capture system is not in place. However, these three alternatives are capable of removing large quantities of DNAPL. As such, the EPA has decided to select a performance-based approach as its preferred alternative for DNAPL removal and hot spot treatment at the Site. Either GW-5, GW-6, or GW-7, or a combination thereof, may be utilized for DNAPL removal and hot spot treatment. The performance criteria will be DNAPL mass reduction so that the ground water PRGs that are presented in Section 5.2 of this proposed plan will be met. The cost for this performance-based approach will vary depending upon the alternatives chosen and the amount of DNAPL that must be removed.

Based on information currently available, the EPA, the lead agency, believes that the performance based Preferred Alternative meets the threshold criteria (40 CFR § 300.430(f)(1)(i)(A)) and provide the best balance of tradeoffs among the alternatives with respect to the balancing criteria (40 CFR § 300.430(f)(1)(i)(B)). The Preferred Alternative would satisfy the statutory requirements of CERCLA section 121 (b), 42 U.S.C § 9621 (b), that is, the Preferred Alternative would:

- Be protective of human health and the environment;
- Be cost-effective; and
- Utilize permanent solutions and alternative treatment technologies or resource recovery technologies (such as recycling/reuse) to the maximum extent practicable.

The Preferred Alternative also would meet ARARs as called for in CERCLA Section 121(d), 42 U.S.C. § 9621(d).

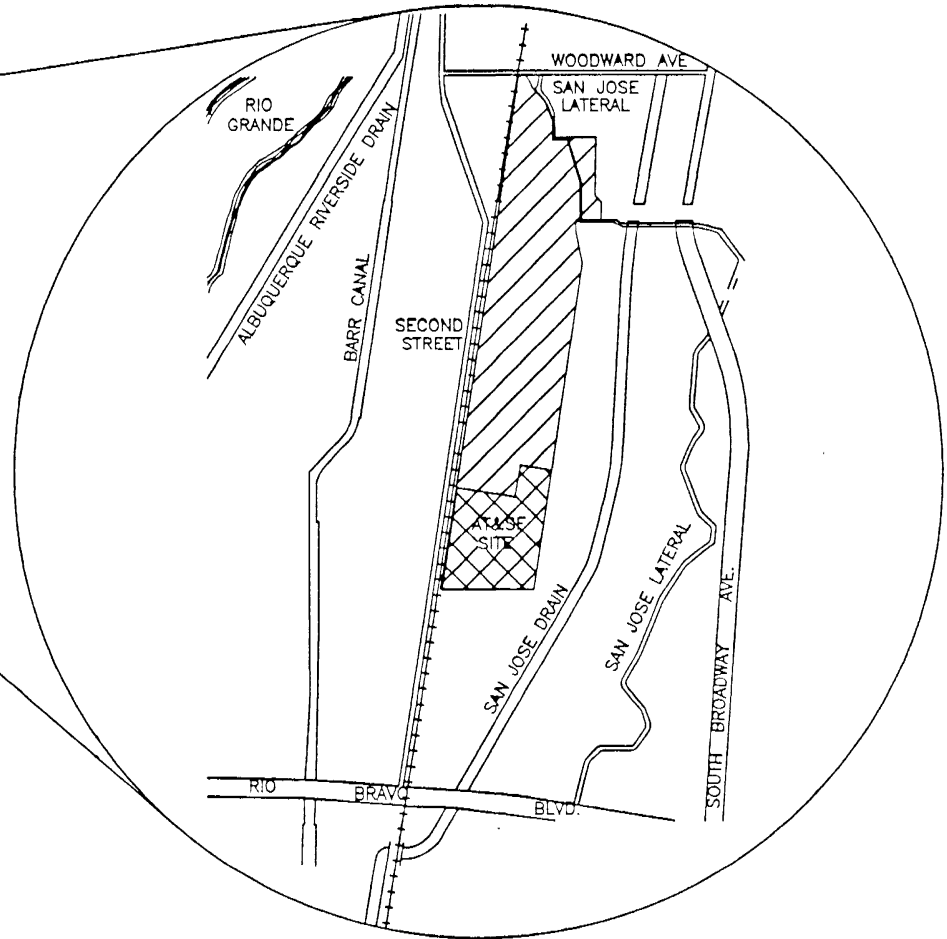
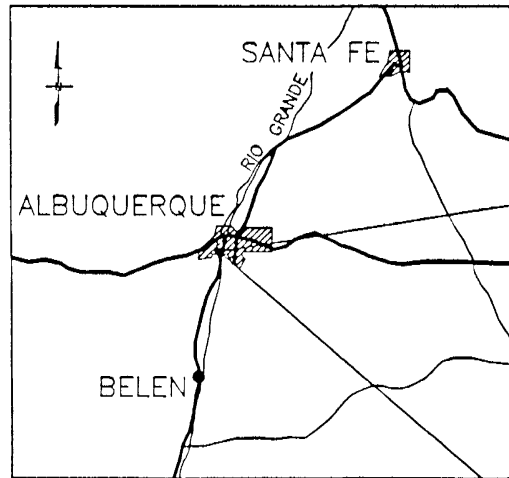
8.1 State, City, and County Acceptance

The EPA, NMED, City of Albuquerque, and Bernalillo County have worked together in the investigation of the Site, and in developing this Proposed Plan.

8.2 Community Acceptance

The proposed remedy may change in response to public comments, or in response to new information. The final selected remedy will be documented in the Record of Decision (ROD) for the Site, which will be issued after the public comment period for this Proposed Plan. The official public comment period will begin on February 7, 2002 , and end on March 9, 2002. Please see Section 1.0 for information regarding the public involvement process.

FIGURES



NOT TO SCALE

LEGEND:



EXTENT OF FORMER TIE TREATING PLANT
AND RAIL YARD



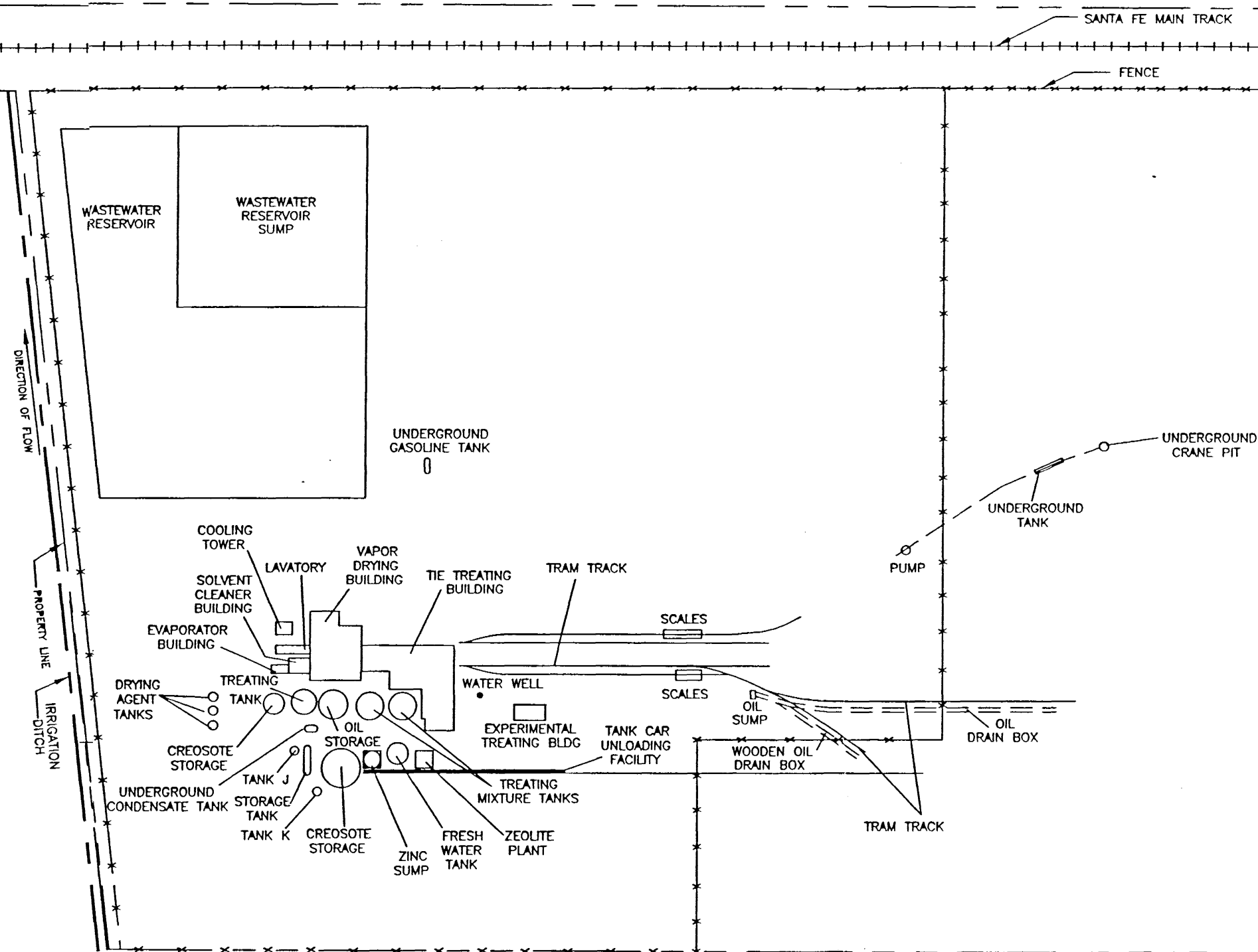
AREA OF FORMER TIE TREATING PLANT

SITE LOCATION MAP

AT & SF SITE
ALBUQUERQUE, NEW MEXICO

TRC

FIGURE 1



0 150 300 FEET
SCALE

LEGEND:

—*—*— FENCE
--- EARTHEN DIKE

NOTE:

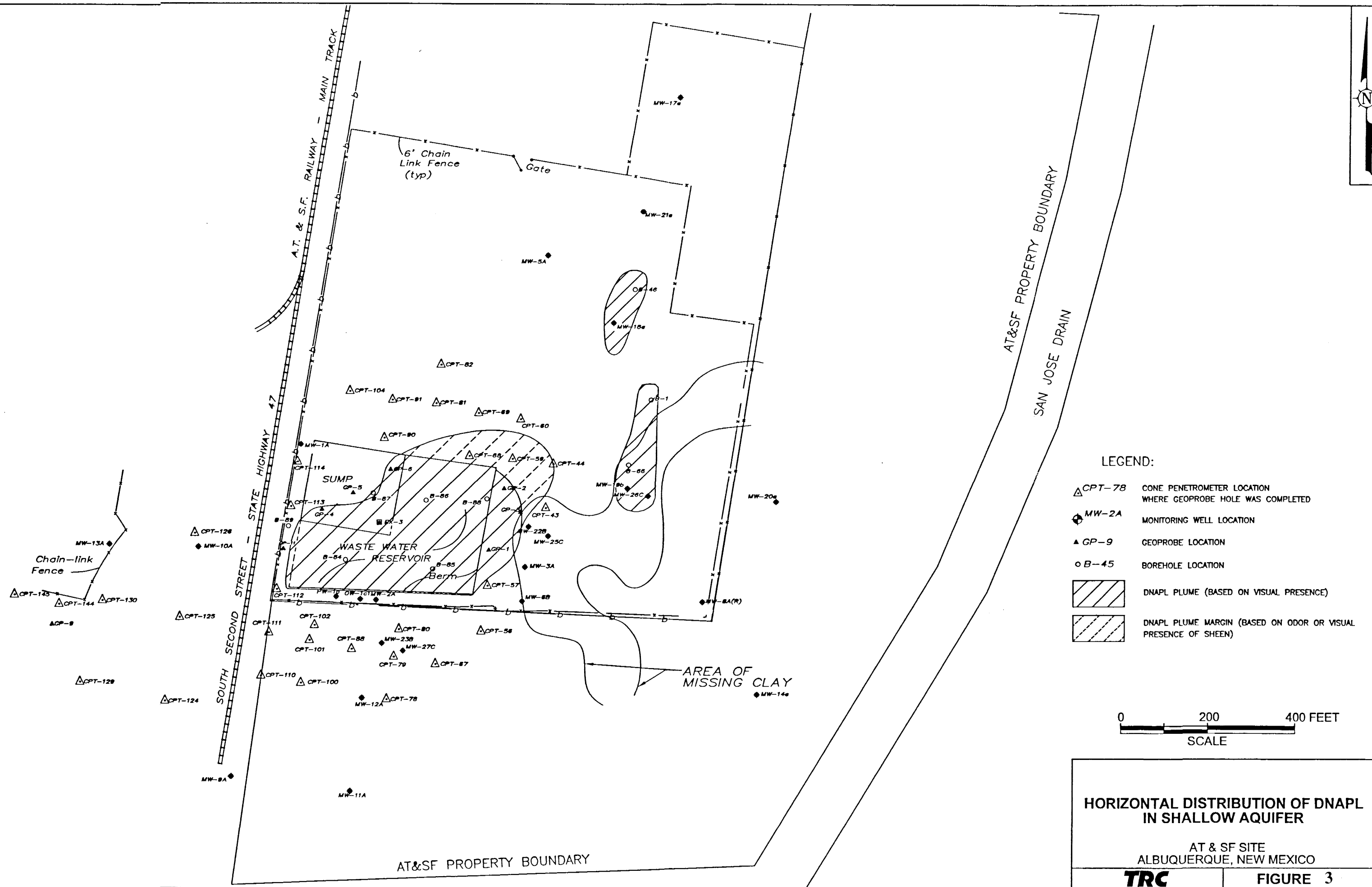
THE TWO UNDERGROUND OIL TANKS ARE IN THE TREATMENT PLANT AREA LOCATED EAST OF THE WASTEWATER RESERVOIR. EXACT LOCATIONS UNKNOWN FROM PLANT BLUEPRINT

AREAL PLOT PLAN SHOWING
FORMER PLANT LAYOUT
OF THE AT & SF SITE

AT & SF SITE
ALBUQUERQUE, NEW MEXICO

TRC

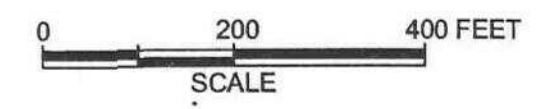
FIGURE 2







- LEGEND
- ESTIMATED HORIZONTAL EXTENT OF DNAPL IN DEEP AQUIFER
 - DNAPL MARGIN IN DEEP AQUIFER BASED ON INFERRENTIAL ANALYSIS AND OBSERVATION OF SHEEN IN SAMPLES
 - MW-28CL MONITORING WELLS
 - B-70 BOREHOLES



HORIZONTAL DISTRIBUTION OF
DNAPL IN DEEP AQUIFER

AT & SF SITE
ALBUQUERQUE, NEW MEXICO

TRC

FIGURE 5



M:\29834\98-126ARI-71REV2.DWG 08-02-00

LEGEND

- Monitor Well - Shallow
- Monitor Well - Intermediate
- Monitor Well - Deep (u - upper, l - lower)
- Benzo(a)pyrene Concentration (>0.2 ug/L)
- 2-Methylnaphthalene + Naphthalene Concentration (>30 ug/L)
- MW-12A**
 Total Semivolatile Concentration (ug/L)
(6.158)
 Benzo(a)pyrene Concentration (ug/L)
(8.158)
 2-Methylnaphthalene + Naphthalene Concentration (ug/L)
(5.158)
- (ND) Not Detected
- (NS) Not Sampled

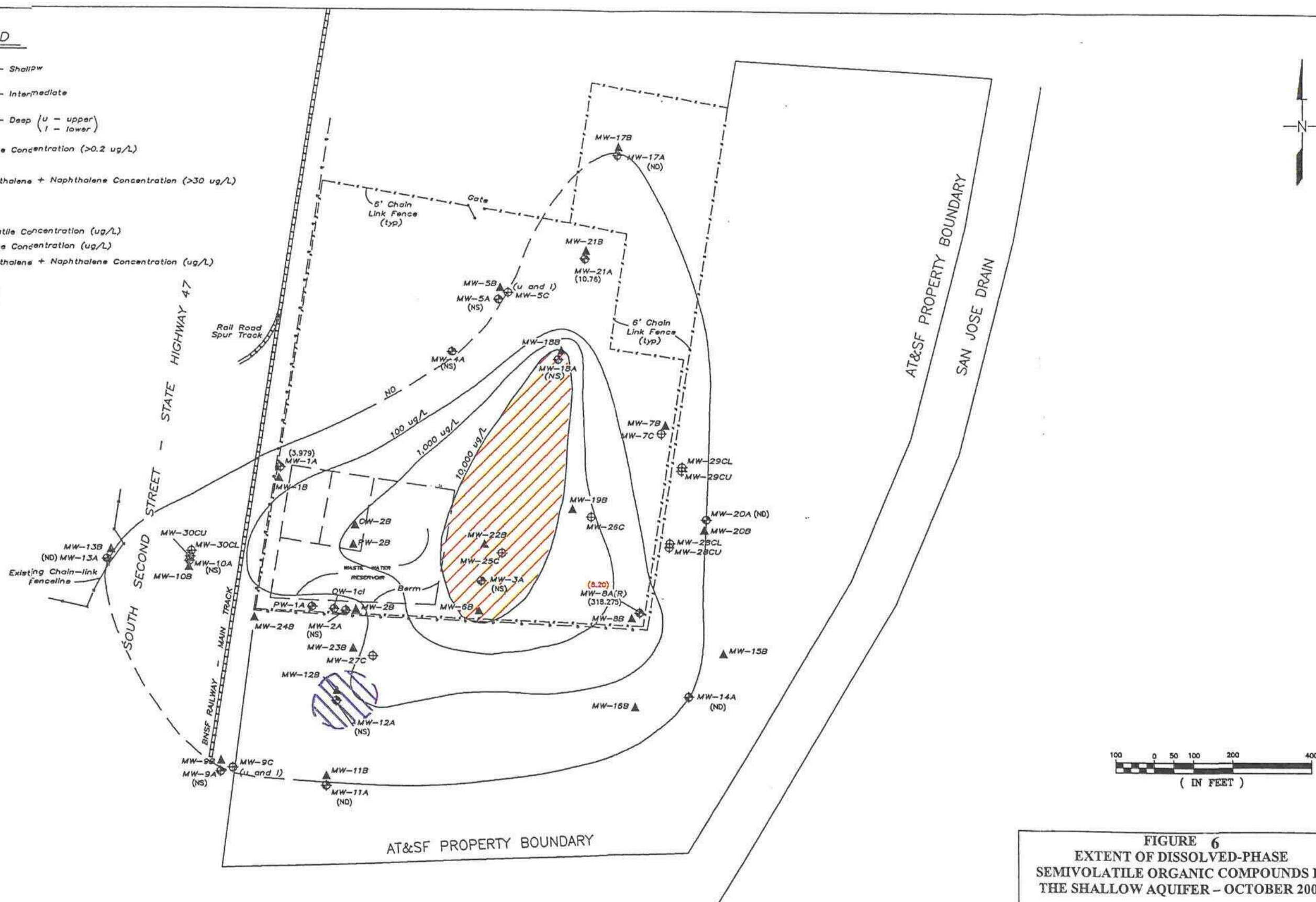


FIGURE 6
EXTENT OF DISSOLVED-PHASE
SEMIVOLATILE ORGANIC COMPOUNDS IN
THE SHALLOW AQUIFER - OCTOBER 2000

AT&SF SITE
 ALBUQUERQUE, NEW MEXICO

TRC

PROJ. No.: 25634
 DWG. No.: N3128ED_00.DWG

LEGEND

-  Monitor Well - Shallow
-  Monitor Well - Intermediate
-  Monitor Well - Deep (u - upper, l - lower)
-  Benzo(a)pyrene Concentration (>0.2 ug/L)
-  2-Methylnaphthalene + Naphthalene Concentration (>30 ug/L)
-  MW-12B
-  Total Semivolatile Concentration (ug/L)
-  Benzo(a)pyrene Concentration (ug/L)
-  2-Methylnaphthalene + Naphthalene Concentration (ug/L)
-  (ND) Not Detected
-  (NS) Not Sampled

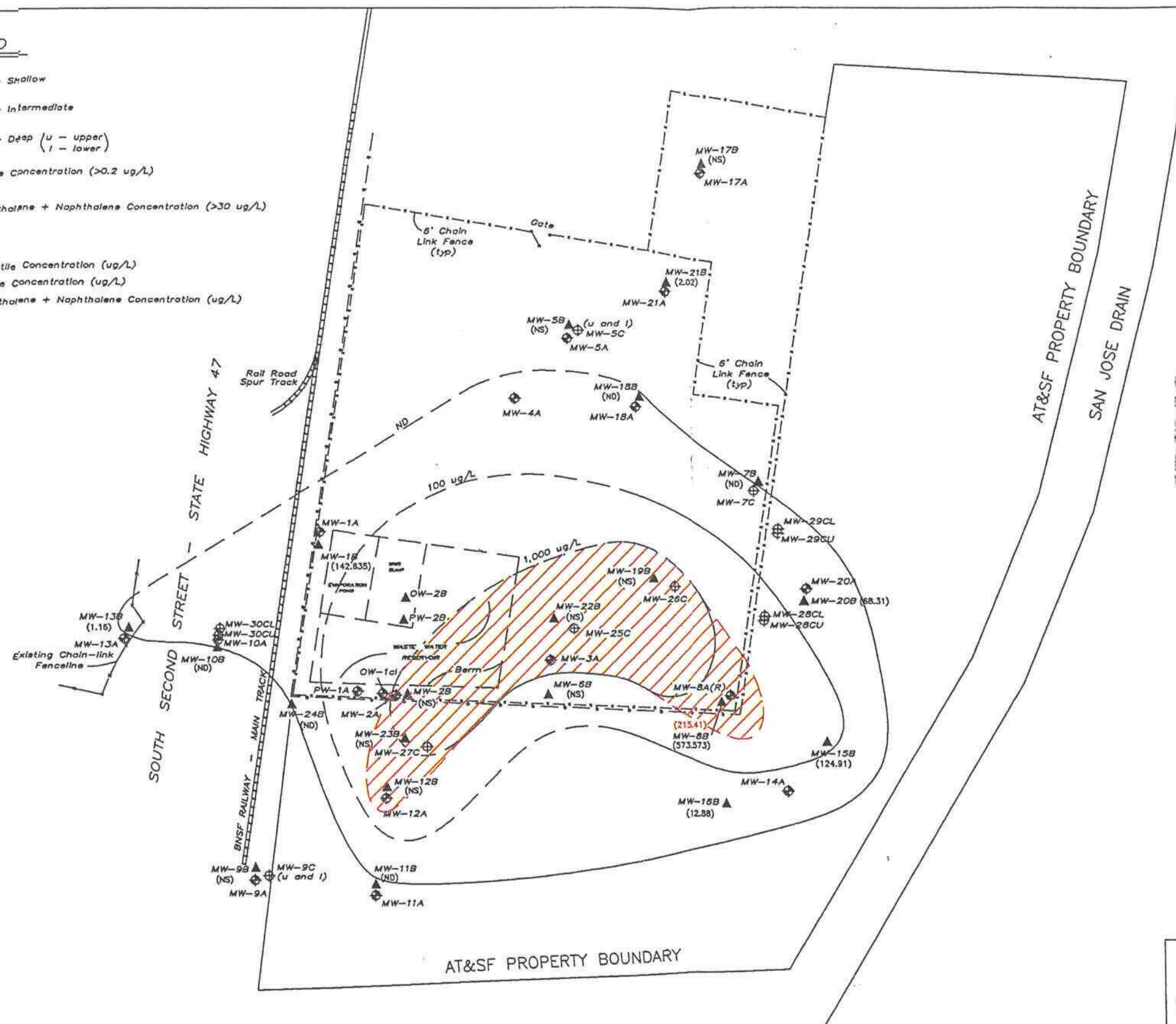


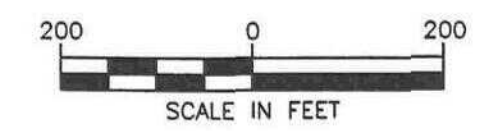
FIGURE 7
EXTENT OF DISSOLVED-PHASE
SEMIVOLATILE ORGANIC COMPOUNDS IN
THE INTERMEDIATE AQUIFER - OCTOBER 2000
AT&SF SITE
ALBUQUERQUE, NEW MEXICO

TRC	PROJ. No.: 25634
	DWG. No.: N3399ED_00.DWG



LEGEND

- ⊕ Monitor Well - Deep
- (6.158) Total Semivolatile Concentration (ug/L)
- (6.158) Benzo(a)pyrene Concentration (ug/L)
- (6.158) 2-Methylnaphthalene + Naphthalene Concentration (ug/L)
- (6.158) Benzene Concentration (ug/L)
- (6.158) Pyrene Concentration (ug/L)
- (ND) Not Detected
- (NS) Not Sampled



2000 GROUNDWATER MONITORING
DEEP AQUIFER
BNSF
A.T. & S.F. SITE
ALBUQUERQUE, NEW MEXICO

PROJECT NO.: 25634	DATE: 7-2-01	 2313 W. SAM HOUSTON PARKWAY N. STE. 107 HOUSTON, TEXAS 77043 713-821-7000	FIGURE 8
TRC Environmental Corporation Customer-Focused Solutions			

PHOTOS



Photo 1 - 1935 Aerial



Photo 2 - 1951 Aerial Photograph



Photo 3 - 1973 Aerial Photograph



Photo 4 - 2000 Aerial Photograph



Photo 5 - Photographs showing Creosote DNAPL during DNAPL recovery trench installation